NOT COPY

REPORT DOCUMENTATION PAGE

AD-A257 063

Form Approved
OMB No. 0704-0188

(1)

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED	
	1992, September	Final	Mar 89 - Dec 89

4. TITLE AND SUBTITLE
Enlisted Personnel Allocation System Field Test Report

5. FUNDING NUMBERS
MDA903-82-C-0552
63007A
792
213
C2

6. AUTHOR(S)
Konieczny, Frank; Brown, George (GRC); and Stewart, John (ARI)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
General Research Corporation
1900 Gallows Road
Vienna, VA 22182

8. PERFORMING ORGANIZATION REPORT NUMBER
1317-34-89-CR

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Research Institute for the Behavioral and Social Sciences
ATTN: PERI-RG
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
ARI Research Note 92-85

11. SUPPLEMENTARY NOTES
Contracting Officer's Representative, Abraham Nelson

42330

92-28451

67 pgs

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

--

13. ABSTRACT *(Maximum 200 words)*

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), with the assistance of the General Research Corporation, undertook a project to modernize and improve the way the Army determines an individual's initial-entry Military Occupational Specialty (MOS). The project developed the Enlisted Personnel Allocation System (EPAS). This report documents the results of the field test of EPAS. The primary objectives of the field test were verification of the conversion to, and operability on, the Army's Information Services Command--Pentagon (ISC-P) computer.

14. SUBJECT TERMS		15. NUMBER OF PAGES
Army accessions	Network optimization	65
Classification	LP optimization	16. PRICE CODE
Person-job-match	REQUEST	--

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

ARI Research Note 92-85

Enlisted Personnel Allocation System Field Test Report

Frank Konieczny and George Brown
General Research Corporation

John Stewart
U.S. Army Research Institute

for

Contracting Officer's Representative
Abraham Nelson

Manpower and Personnel Policy Research Technical Area
Clinton B. Walker, Acting Chief

Manpower and Personnel Research Division
Zita M. Simutis, Director

September 1992

United States Army
Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Technical Director

MICHAEL D. SHALER
COL, AR
Commanding

Research accomplished under contract
for the Department of the Army

General Research Corporation

Technical review by

Roy D. Nord
Dennis H. Winn

NOTICES

DISTRIBUTION: This report has been cleared for release to the Defense Technical Information Center (DTIC) to comply with regulatory requirements. It has been given no primary distribution other than to DTIC and will be available only through DTIC or the National Technical Information Service (NTIS).

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The views, opinions, and findings in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other authorized documents.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	1992, September	Final Mar 89 - Dec 89

4. TITLE AND SUBTITLE
Enlisted Personnel Allocation System Field Test Report

5. FUNDING NUMBERS
MDA903-82-C-0552
63007A
792
213
C2

6. AUTHOR(S)
Konieczny, Frank; Brown, George (GRC); and Stewart, John (ARI)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
General Research Corporation
1900 Gallows Road
Vienna, VA 22182

8. PERFORMING ORGANIZATION REPORT NUMBER
1317-34-89-CR

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Research Institute for the Behavioral and Social Sciences
ATTN: PERI-RG
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
ARI Research Note 92-85

11. SUPPLEMENTARY NOTES
Contracting Officer's Representative, Abraham Nelson

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE
--

13. ABSTRACT *(Maximum 200 words)*

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), with the assistance of the General Research Corporation, undertook a project to modernize and improve the way the Army determines an individual's initial-entry Military Occupational Specialty (MOS). The project developed the Enlisted Personnel Allocation System (EPAS). This report documents the results of the field test of EPAS. The primary objectives of the field test were verification of the conversion to, and operability on, the Army's Information Services Command--Pentagon (ISC-P) computer.

14. SUBJECT TERMS
Army accessions
Classification
Person-job-match
Network optimization
LP optimization
REQUEST

15. NUMBER OF PAGES
65

16. PRICE CODE
--

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std Z39-18
298-102

ENLISTED PERSONNEL ALLOCATION SYSTEM FIELD TEST REPORT

CONTENTS

LIST OF TABLES

CONTENTS (Continued)

Page

LIST OF FIGURES

ENLISTED PERSONNEL ALLOCATION SYSTEM
FIELD TEST REPORT

I. INTRODUCTION

The purpose of the field test is to validate the conversion effort undertaken to transfer the prototype EPAS to an Army operational facility--specifically, that at the Army's Information System Command-Pentagon (ISC-P). Prior research and development demonstrated the utility of the EPAS to the Army in a research-oriented environment. To facilitate the field test, a field test plan was developed, presented, and approved by ARI. This report presents the field test results.

In Section 2 we present an overview of the Army's process for accessioning people and discuss how limitations motivated EPAS. In Section 3 we present the EPAS concept. In Section 4, we discuss how we adapted the functions to the Army environment, and details of the EPAS implementation are given in Section 5. Section 6 discusses the results of the field test.

II. BACKGROUND FOR EPAS CONCEPT

Every year, over 300,000 people apply to join the Army. Here we present an overview of the eligibility standards these applicants must meet, how they are processed to join the Army and how the Army's Recruit Quota System (REQUEST) supports this process. We then discuss some limitations of REQUEST that motivated EPAS.

ELIGIBILITY STANDARDS

The Army uses the Armed Services Vocational Aptitude Battery (ASVAB) to determine mental qualifications to enter the Army. The ASVAB includes subtests that form the Armed Forces Qualification Test (AFQT), which determines enlistment eligibility, and other tests for qualifying in nine job families.

The Army particularly desires applicants who are high school graduates and whose AFQT scores place them in the top half of the general population. These are called quality applicants. Also, the Army is prohibited by Congress from accepting applicants from the bottom 10 percent of the population and has administratively decided against accepting those in the lowest quartile.

THE ARMY ACCESSION PROCESS

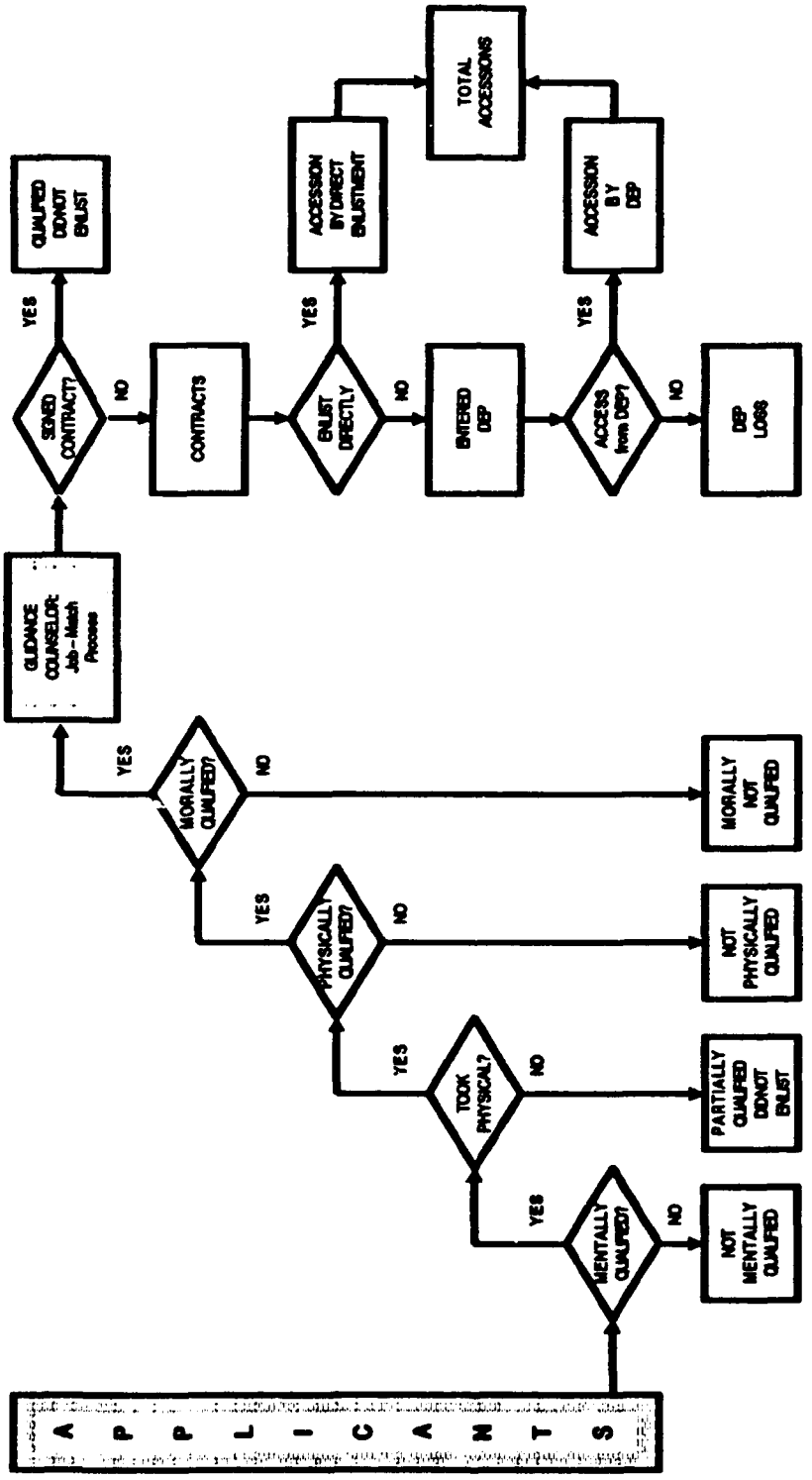
Applicant Screening and Processing

Figure 1 illustrates the steps applicants go through in the enlistment process. Applicants first take the ASVAB to determine the jobs for which they qualify. They then discuss a range of potential jobs and job-specific enlistment incentives with a local recruiter.

Mentally qualified applicants then report to 1 of over 60 Military Enlistment Processing Stations (MEPS) for a physical examination and a careful evaluation of their high school graduation credentials. Full disclosure of any police record is also required.

After satisfying the mental, physical, and moral standards, the applicant is offered a job assignment by an Army guidance counselor and signs an enlistment contract. This contract guarantees the type of training he or she will receive and any associated incentives for electing that job. The applicant then returns home until it is time to report for active duty (up to 12 months in the future). This time between contract signing and reporting for active duty is permitted by the Delayed Entry Program (DEP).

Figure 1. Army Personnel Accession Flow.



The Job Classification Process

The Army considers it essential that applicants agree to train for a specific job before they enlist. Therefore, there is considerable negotiation when the applicant discusses jobs with the guidance counselor. The negotiation process has, conceptually, three significant components which affect the final decision:

- The Guidance Counselor--how well does the guidance counselor "sell" jobs to potential recruits.
- The Applicant's Preference--what does the applicant want and to what extent will he/she be amenable to accepting the jobs which best meet the Army's needs?
- The Generated MOS List--how well does the computerized support system meet the abilities and desires of the applicant as well as the Army's goals and requirements?

The Guidance Counselor

Guidance counselors are all former recruiters who have a demonstrated ability to work with the young applicants. They are supported by the REQUEST computer system, which maintains the status of open seats in MOS training classes and reserves a seat in the class that an applicant selects. It provides class seat availability information to the guidance counselor via two modes:

- Look-up. In this mode, the guidance counselor requests seat availability information for a specific MOS' training. REQUEST responds with any open class dates within the specified range of dates.
- Search. In this mode, the guidance counselor provides the range of dates the applicant would like to begin training and one MOS of the applicant's choosing. REQUEST recommends the MOS (with associated class dates) to which the applicant should be assigned. The Search Mode currently displays up to five [computer] screens of five job recommendations. If the applicant's preference is not one of the first 25 jobs, it will be shown as a sixth recommendation on the third screen.

Current policy dictates that the guidance counselor is to use the Search Mode for classifying applicants.

Within the job classification system, the guidance counselor is essentially a skilled salesman. The techniques he employs, and his degree of success in "selling" jobs to applicants, will have a significant impact on the final results achieved from the overall system. Selling strategies may include:

- Only showing the first screen of five jobs to an

applicant who has minimum qualifications; essentially saying "take it or leave it."

- Showing all possible jobs to a highly qualified applicant.

- Call The US Army Recruiting Command (USAREC) for permission to allow a highly qualified applicant to join a filled training class.

- Encouraging an applicant to accept a job with a nonmonetary incentive (such as a guaranteed assignment to Hawaii) rather than one with a monetary incentive (such as the Army College Fund or an enlistment bonus).

Applicant Preference

A key point in the job classification system is that the Army (through the guidance counselor) does not directly assign applicants to jobs, it merely recommends combinations of jobs and training dates. While the applicant;s selection may be considerably influenced by the guidance counselor's "sales" ability, the applicant makes the final decision.

Table 1 based on FY87 accessions, shows that considerable variability exists in negotiating with applicants. This table shows that almost 50 percent of the quality (AFQT Category I-IIIA) applicants were allowed to select a job other than one shown on the five screens with recommendations; conversely, over 50 percent of the applicants in categories IIIB and IV selected from the first screen (the first five job choices).

Table 1. Job Distribution by Screen

SCREEN	--- I-IIIA ---		---- IIIB ----		----- IV -----	
NUMBER	COUNT	PCT	COUNT	PCT	COUNT	PCT
1	15218	22	13924	49	2794	69
2	8201	11	4828	17	593	15
3	5748	8	2784	10	262	7
4	4471	6	1727	6	141	4
5	3413	5	994	4	73	2
OTHER	34784	48	4132	14	162	3
TOTAL	71835	100	28389	100	4025	100

The ordered list appears to generate considerable influence even for the quality recruits. MOS on the first screen are about twice as likely to be filled for quality recruits. Thus, the presentation order represents an important factor in the Army's ability to successfully fill MOS requirements.

Generated MOS List

The module within REQUEST which generates the list of job recommendations also has considerable influence in job classification. This module selects from up to 10,000 combinations of jobs and training dates to create the 25 recommendations to be used by the guidance counselor. Jobs are shown in the order of the Army's priority, the rate at which the jobs are being filled, minimum qualification requirements, etc. Since guidance counselors are encouraged to "sell" one of the five jobs on the first screen, the computer-generated recommendations will have a significant impact on how well the Army meets its annual goals and requirements.

LIMITATIONS OF CURRENT ARMY CLASSIFICATION SYSTEM

While the guarantee of specific job training is a useful recruiting incentive for the Army, the classification process must be managed carefully to meet the following requirements:

- Fill yearly job requirements.
- Keep job training classes from becoming too large or small.
- Keep popular jobs from being "sold out" to marginally qualified applicants.
- Ensure a supply of desirable jobs to attract quality applicants.

The goal of the present Army person-job match system, REQUEST, is to fill all open job requirements. While it does well at filling open jobs, it often must sacrifice good classification recommendations to support near-term fill of critical jobs. REQUEST's limitations include:

- It cannot "look ahead" and match the projected applicant supply to the remaining job opening.
- It cannot take corrective action to avoid problems nor estimate how policy changes will affect the future supply and distribution of personnel.
- It cannot make trade-offs between important objectives such as minimizing attrition and maximizing job performance.

III. EPAS CONCEPT

HOW ARMY CLASSIFICATION DIFFERS

The Army recruiting environment differs from most job assignment problems because:

- Army job classification is sequential; applicants must be offered jobs as they volunteer at one of the Army's 60 recruit classification centers throughout the year.
- Applicants can reject a proffered job.
- If the initial job offer is rejected, guidance counselors may renegotiate a job closer to the applicant's interests.

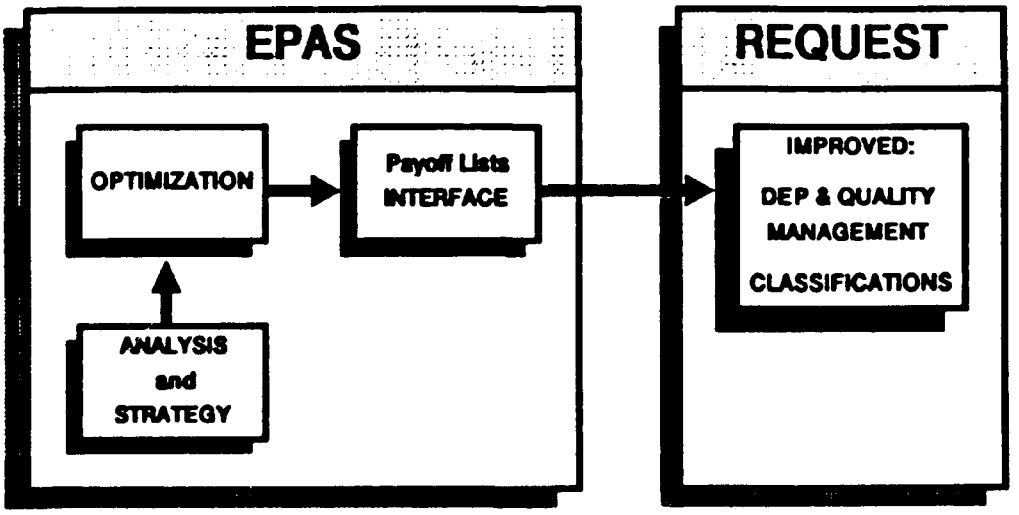
These conditions are quite different from the general structure of problems typically addressed by optimization methodologies. Optimization normally can only support assignment of groups of individuals. A further complication was that optimization gives a single "best" solution, which would likely not be followed since applicants can have discretion in choosing a job and training date.

EPAS APPROACH

The EPAS challenge was to develop a methodology that could apply the "look ahead" insights from an optimization to a day-to-day sequential classification process. To our knowledge, this type of problem has not previously been addressed.

Briefly, the EPAS approach uses information from a linear programming optimization solution. How this process works is best explained in the context of the full EPAS, as shown in Figure 2.

Figure 2. EPAS-Enhanced REQUEST.



EPAS' Components

EPAS has, conceptually, three primary components:

- Optimization routines
- Analysis and Strategy routines
- REQUEST Interface routines

Optimization Routines

These routines comprise the essential core of the EPAS process, generating the optimal allocation information to be used by the other system components. Principle aspects of the Optimization routines are:

- Applicant Forecasts. EPAS can generate alternative forecasts by educational level and AFQT score for policy analysis. The standard operational mode is to use forecasts that are based on the USAREC mission statements.
- MOS Requirements. EPAS uses the training requirements from the REQUEST system. Other MOS requirements, such as quality targets and limits, are determined from Army personnel policy. The monthly accession limit is acquired from the ELIM-COMPLIP system.
- Linear Programming Optimization. The optimization is the key to EPAS' capabilities. Its inputs are the MOS training requirements and the number of forecasted applicants. Using a structure that incorporates important recruiting policies (discussed below), the optimization recommends job assignments for the different types (gender, education, quality, differential performance) of applicants forecasted to volunteer during the next recruiting week. This allows it to recommend job assignments which meet Army goals while considering trade-offs among applicant performance, availability, and timing of accessions.

Analysis and Strategy Routines

These routines provide EPAS with the ability to perform extensive "what if" analyses. Heuristic simulation routines emulate the interaction between guidance counselor and recruit, generating probable accessions based on policies in effect. Coupled with statistical and report generation procedures, this provides Army managers to analyze the probable impact of alternative strategies prior to their implementation.

REQUEST Interface Routines

The optimization's solution represents only one of many

possible sets of individual job assignments. Factors such as specific qualifications, interests, and the short-term availability of jobs often preclude this solution.

The optimization, therefore, creates payoff lists of recommended assignments for the different types of applicants. Thus if the optimal recommendation is not chosen, alternative feasible recommendations are made in order of their desirability.

The Applicant Classification Process

REQUEST will operate much like it currently does in that it will recommend job assignments and training start dates as each applicant appears for classification. A significant difference, not observable by the Army guidance counselors, is that REQUEST will incorporate the payoff lists from the EPAS optimization in its classification recommendations. These preference lists, communicated through an interface routine, then provide "look ahead" intelligence for the guidance counselors' day-to-day classification recommendations.

IV. ADAPTING EPAS TO THE ARMY RECRUITING ENVIRONMENT

GROUPING APPLICANTS AND ARMY JOBS

With about 6,000 different combinations of Army jobs and training class start dates, it would be intractable for an optimization model to assign individually 140,000 recruits to a job-class date. The following aggregations scope the problem to a reasonable size.

- The annual accessions are grouped into approximately 80 supply groups which are based on aptitude area test performance while preserving demographics, such as education and gender, that are important for Army job assignment.

- The [260] Army jobs are grouped into (approximately) 50 clusters which preserve differentiability for predicted performance and incorporate Army assessments of job priority and difficulty.

- Monthly aggregations of both recruit arrivals and job training classes are used for accession planning.

The optimization's solution assigns members of supply group (i), who sign an enlistment contract in a particular month (j), to a job cluster (k), with training beginning in month (m). Depending on Army requirements, EPAS can be configured to use one of several objective functions, including:

- Assign applicants to jobs so that the sum of their aptitude area composite scores is maximized.

- Assign applicants so that their predicted attrition (unplanned termination of service before completing their enlistment contract) is minimized.

- Assign applicants based on a combination of the above two functions.

The payoff lists are thus the "best" job cluster-training class month (hence called job-month) combinations for the supply group members who are projected to sign enlistment contracts in the current month.

MODEL CONSIDERATIONS FOR THE EPAS LINEAR PROGRAMMING OPTIMIZATION

The EPAS design is motivated by the following five key recruiting management considerations.

MOS Training Plan

The annual training plan specifies the 6,000 combinations of training start dates and available seats. Total annual requirements for each job type must be met. The training plan also states minimum, optimal, and maximum class sizes. Because the Army Reserves and National Guard share training, the optimization does not have to meet every class size lower bound. However, EPAS attempts to fill classed to the optimal level.

Job Eligibility Requirements

Army jobs have eight different combinations of eligibility requirements based on gender (no women are allowed in combat jobs), AFQT score, and high school graduation. Additionally, a qualifying aptitude area test score must be met.

Quality Requirements

Quality applicants score in AFQT categories I-IIIA, representing the top half of the general population. The Army also accepts applicants from AFQT categories IIIB and IV. Some jobs require all quality applicants but for the jobs that accept AFQT categories IIIB and IV applicants, the Army sets a minimum proportion of quality recruits. This helps ensure that each job's annual cohort of recruits will have sufficient leadership potential. The annual accessions of each job must meet these goals, and they should also be reflected in the composition of each job-month training class.

In addition to goals for quality recruits, many jobs have limits on the number of AFQT Category IVs. Given that a limited number of quality recruits are available, these limits on AFQT Category IVs have the effect of forcing the use of AFQT Category IIIBs.

The Delayed Entry Program

Applicants volunteer in seasonal patterns which do not coincide with the Army's requirements for jobs. Also, there are cost savings in having an even flow of recruits through training. Although recruits could wait on active duty for training to start, the DEP is a lower cost way to control recruit flow. It may also promote other savings. Manganaris and Phillips (1985) estimated $50M annual savings if the Army increased DEP lengths so the recruits with poor motivation for service could drop out of the DEP rather than prematurely leave the Army after beginning active duty.

The DEP is also important in recruiting high school seniors. They can sign contracts, then stay in school until graduation. In general, current and potential DEP policies permit different DEP lengths based on applicants' educational status and test scores.

Monthly Accession Requirements

Once applicants are accessed onto active duty to begin training, they begin receiving pay and count against the Army's authorized personnel strength. The ELIM-COMPLIP model (Holz and Wroth, 1980) estimates losses and computes the total monthly accessions that the Army must attain to meet, but not exceed, its authorized monthly strength. The flexibility in class size is such that the sum of all jobs' maximum class sizes for a given month well exceeds the monthly accession target. However, the total annual requirements for jobs will equal the sum of the monthly accession requirements. The flow into the training base must not exceed the ELIM-COMPLIP estimate.

V. EPAS IMPLEMENTATION

OVERVIEW

The contract objective was to investigate techniques for, and create a prototype of, a system which could support real-time enlisted personnel classification as performed by the REQUEST system. The development of the prototype was conducted in three stages: baseline, full-scale in a research setting, and full-scale in an operational environment.

Baseline Prototype

The baseline prototype was developed using only ten MOS and a subset of the recruit population. The methodology used a network approach for optimization. The prototype was developed on the Decision Laboratory Facility (DLF), a mini-computer based system designed and developed to support this effort. The DLF used a Wicat Model 160, a MC-68000 based machine. The baseline demonstrated the general feasibility of the EPAS approach.

Full-Scale Prototype

The full-scale prototype was initially developed on the DLF. Its implementation incorporated the full set of initial entry MOS, random sampling from the entire recruit population, and the addition of Army policy constraints--Delayed Entry Program (DEP), quality goals, and skill restrictions. At this point the system outgrew the DLF. The facility was unable to support simulations.

Therefore, the system was converted to run on the National Institute of Health (NIH) mainframe, an IBM System/370 Model 3090-200 which utilities a vector facility to provide a supercomputing capability. This conversion entailed a complete code rewrite from Pascal to PL/1 and changing the data storage format from WICAT's Keyed Sequential Access Method (KSAM) to IBM's Virtual Storage Access Method (VSAM).

Simulations of the full-scale prototype were then performed to test and evaluate the EPAS design. These results substantiated the EPAS design and demonstrated the potential savings to the Army. The GRC Report Evaluating the Benefits and Costs of the Enlisted Personnel Allocation System, 1317-23-86-CR, June 1986 provides the details.

Operational Prototype

While the NIH full-scale prototype confirmed the EPAS methodology, it also raised two issues: (1) the cost of running the system on the NIH computer and (2) the impact of running the system in an operational as oppose to a research-oriented environment. To address these issues, the system was converted to run on the Army's ISC-P computer facility.

Two new design issues were also addressed. These were the use of a linear programming optimization, instead of a network, and the redesign of the user interface routines.

Linear Programming Formulation

The network formulation of the earlier prototypes forced several design restrictions in order to avoid non-network constraints. A linear programming formulation was developed to meet these design issues. A detailed description of the formulation can be found in the GRC Report Final Annual Report (7th Year), 1317-35-89-CR, December 1989.

User Interface Routines

The EPAS prototype has been designed as a user-centered, menu-driven system to facilitate the data manipulation necessary for analyses. With the original prototypes (both on the Wicat and the NIH computer systems), the screens were "hard-coded" using standard ASCII protocols. These protocols are unacceptable in the Army's operational environment.

IBM equipment, in particular the 327x-type terminals in the ISC-P and HQDASS environments, do not support ASCII protocol, but instead utilize an IBM-specific message header protocol. On the NIH computer, GRC personnel bypassed this problem by developing a special program which intercepted and interpreted the ASCII control codes.

This approach would not be acceptable in an operational environment because of the delays incurred while processing the control codes and the portability and maintainability problems that exist with such a design. Hence, GRC rebuilt the primary user menus and programming logic using the IBM's Cross System Product (CSP) facility. The GRC Report Final Annual Report (7th Year), 1317-35-89-CR, December 1989 covers the CSP development.

VI. FIELD TEST

The primary purpose of the Field Test is to validate the conversion effort undertaken to transfer EPAS to an Army operational environment. To facilitate the field test, a field test plan (GRC Report Field Test Plan, 1317-28-87-CR, April 1987) was developed and approved by ARI.

The field test originally called for five simulations, a baseline and four scenarios. Due to funding constraints, only the baseline and two scenarios were completed.

An operational problem outside of our control also impacted on full analysis of the simulations. Our user logon identifications were canceled several times without prior notification. Delays in reinstating the logon ID's resulted in lost output and an inability to access and analyze previously saved output.

The available reporting statistics, along with the EPAS trace reports (i.e., internal EPAS reports which monitor the individual EPAS modules), substantiated the ISC-P conversion effort, and provided information, though limited, to address the following questions:

- How well does the system predict the outcome of alternative personnel actions?
- How well can the prototype adapt to changing circumstances such as international tensions, legislative mandates for changing force size, introduction of new weapons, etc.

The remainder of this section describes the specific EPAS test scenarios and their results. Appendix A contains the data for the Baseline Scenario. Appendix B provides the data unique to alternative other scenarios.

BASELINE SCENARIO

Each of the test scenarios which follow deliberately perturbs some aspect of the normal operating environment. Clearly, these perturbations can not be applied to the "real-world" to determine whether or not EPAS predicts what actually happens. For example, one could not introduce a new weapon system (Test Scenario Three) to ascertain if EPAS correctly functions in such an environment.

Instead, a Baseline Scenario, representing a normal recruiting operating environment was established. ARI decided on FY87 for developing the baseline. Test scenario results can then be contrasted against the baseline results to determine if EPAS correctly detected and responded to the perturbations in the operational environment.

A second significant result to be obtained from the Baseline Scenario was the definition of baseline statistics. These provide the capability of analyzing and verifying the EPAS simulation methodology in a controlled environment.

Baseline Data Requirements

To simulate the FY87 recruiting environment, EPAS requires the relevant recruit, training, and policy data. GRC Report Final Annual Report (5th Year), 1317-31-87-CR provides an overview of the EPAS design including a detailed description of its data. Appendix A contains a condensed list and description of these data requirements. The data processing required for the field test is described in the following sections.

Primary Recruit Files

The EPAS Primary Recruit File maintains historical, recruiting-related information (demographic characteristics, ASVAB and aptitude area scores, bonus information, selected entry level MOS, and etc.) on the potential Army recruits.

Previously, our primary source of this data consisted of the monthly Military Entrance Processing Station (MEPS) transaction tapes. Earlier analyses identified a minor problem existed with these tapes. EPAS projects the number of high school graduates and seniors who sign contracts (high school seniors must wait until after graduation to actually start training). Therefore, it needs reliable data on the number of contracts of each type during the year.

The education field on the MEPS tapes reflects the education level of the individual at the point of his/her latest transaction. Due to the follow-on visits after the contract signing and the subsequent transaction record modifications, this field was found to underestimate the number of high school seniors.

To resolve this problem, USAREC supplied us with the MINIMASTER tapes for FY86 and FY87. These tapes combine data from two sources, MEPS and REQUEST. The MINIMASTER record contains two education fields, the previous and current education level. The previous education level is derived from the REQUEST data source, if it exists, otherwise it is taken from the MEPS data. We found that this field provided a much better estimate of the education level at contract time, and therefore decided to use the MINIMASTER tapes as our primary source of recruit data.

The MINIMASTER tapes were processed to generate primary files for FY86 and FY87. The processing consisted primarily of data validation and conversion from the MINIMASTER format to the EPAS format.

Accession Limits

The Enlisted Loss Inventory Model Computation of Manpower Programming using Linear Programming (ELIM-COMPLIP) system provided the annual Army accession limits.

MOS Training Requirements

The Military Occupational Specialty Level System (MOSLS) was to provide us with the training requirements data, but it lack the level of detail required by EPAS. The majority of the training requirements data was obtained from Keystone reports, the 31 October 1986 Enlisted Career Management Fields and Military Occupational Specialties--Army Regulations 611-201, and the January 1987 Occupational Conversion Manual. Annual accession requirements for each MOS were derived from the primary files, and included FY86 contracts who accessed in FY87 and those who contracted and accessed in FY87.

Simulated Applicant Stream

A random sample of 10,000 contracts were generated from the FY87 primary file based on its monthly demographic distribution.

MOS Cluster Definitions

Our MOS Cluster definitions has been developed on the MOS available in FY86. Modifications were made to handle new and converted MOS for FY87.

Mission Blocks

We used the annual USAREC Mission Blocks available at the beginning of FY87.

MOS Quality Goals

As with the MOS training requirements, the historical primary files were used to obtain estimates of the quality goals for each MOS.

School Seat Plan

We were unable to obtain this information from the Army Training Requirements and Resources System (ATRRS). Instead, we used the primary files to derive the class minimums, maximums, nominals and start dates. Adequate for our field test, but not so for a truly "operational" environment.

Supply Group Definitions

The FY86 Supply Group Definitions (generated using the MEPS-based primary file) were used with no modifications. Though the MEPS data underestimated (overestimated) the size of the high school senior (graduate) population, we decided that our sample sized were large enough for our purposes.

Baseline Results

The previously mentioned, operational problems at ISC-P and funding limitations restricted our analysis to summary statistics. For the Baseline Case, EPAS was able to obtain 87 percent of the annual training requirement and 93 percent of the annual quality goal. We were unable to compute the mean predicted performance, as this information is generated from EPAS detail reports.

These figures were considerably lower than achieved in previous (Network-based) simulations. Analysis indicated that the reason for the lower values derived from the basic LP formulation being used in the revised EPAS. The network formulation was unable to model Basic Training (BT) as a separate entity. Thus, EPAS had access to Advanced Individual Training (AIT) classes in every month of the simulation.

The LP formulation, on the other hand, models BT and AIT separately, enable a more realistic simulation of the accession and training process. The formulation caused an adverse affect, however, as it prevents the model from assigning any new AIT trainees in the first two months of the simulation. This restriction is caused by the, approximately two month, delay time needed to complete BT; i.e., personnel assigned by the model in the first month of simulation are not available to being AIT until they complete BT in the third month of the simulation.

EPAS was limited, therefore, to One Station Unit Training (OSUT) MOS and existing Delayed Entry Program (DEP) personnel to meet accessions in the first two months of the simulation. As shown in Table 2, the fill in the first two months of the simulation fall significantly short of the available limit. Limitations in class capacity and forecasted supply prevent the model from recovering this initial shortfall.

Table 2. Initial Fill Shortfall

SIM MONTH	AAMMP LIMIT	FILL	SHRT-FALL
8701	1208	516	692
8702	915	573	342
	2,123	1,089	1,034

We concluded that the shortfall was not inherent problem of the revised optimization formulation, but a dilemma which could be addressed through either, or both, of two techniques:

- Fine tuning of model-making minor adjustments to the parameters involved in the formulation an execution of the model. In particular, a preliminary "jump start" may be in order, allowing EPAS to initialize the first to months of the simulation.

- Data analysis--the extreme shortfall in the first two months leads one to believe that GRC analysts are not correctly interpreting the data, i.e., the AIT seats for the initial months should be already filled if annual goals are to be met. Additional analysis of identified and, potentially, additional (e.g., ACT) data sources might identify additional resources already committed. Given additional resources sufficient to meet the requirements of the initial two months of the simulation, we anticipate performance similar to that achieved with the network formulation.

Time and funding did not allow verification of either of these hypotheses. We determined, however, that the results from the Baseline Case provided sufficient information to continue the Field Test as:

- It demonstrated that the revised model would execute in the ISC-P environment with the enhancements and modifications incorporated during the conversion process. All data was generated from identified sources and the model successfully executed through twelve iterations (one year).

- The results obtained from the executions would provide a statistical baseline for measuring alternative, test scenarios relative to a standard condition.

TEST SCENARIOS

The rest of this section covers the specific scenarios. Originally four scenarios were planned, but funding limited us to running two.

Scenario 1: Unanticipated Supply Population

Issue: How well does the system predict outcome of alternative personnel actions?

Introduction

"Alternative personnel actions" implicitly fall into two categories: those over which the Army has control and those over which it has no control. The Army actively manages personnel actions of the first type through the implementation of various policy alternatives.

Within the limits imposed by law, fiscal constraints, etc., the Army has a degree of latitude to determine the precise configuration of its NPS recruits. This freedom is exercised by definition of specific policies which define what types of actions are to be taken. Examples of this type of control might include changing quality goals, redefining mission blocks, and so forth.

Virtually all of the many parameters used by EPAS may be changed by the user, either by defining data files with external systems or by manually altering data using EPAS' interactive, menu-driven user interface routines.

As part of the earlier development and testing of EPAS an extensive benefit/cost analysis was conducted and reported in Schmitz and McWhite (1986). Many of the kinds of actions within this first category were addressed as part of this test, including:

- Changing the training plan
- Lower quality goals
- Increased applicant flexibility in choosing the initial assignment.

The results of these earlier tests document EPAS' ability to respond to policy changes over which the Army is exercising control through policy variations. For purposes of the field test, therefore, we have elected to focus on the second category of personnel actions: those over which the Army has no control.

Description of First Test Scenario

An example of actions over which the Army has no control is the characteristics of applicants. While mission blocks define

the desired quality distributions, the Army must choose its NPS recruits from the population which actually applies. If the actual population is significantly different from the anticipated/desired population, problems might arise in meeting both annual requirements and quality goals.

The first test scenario simulated this type of occurrence by generating a sample population with significantly different characteristics than those defined by the mission blocks. Table B-5, Appendix A, shows the FY87 Mission Blocks used for all the test scenarios. The distribution of the sample population used with this test scenario are depicted in Table 3.

All other parameters within the simulation remained the same as defined in the Baseline Scenario. For example, the quality goals for each MOS will remain the same even though a significant drop in applicant quality is being simulated.

This scenario presented a major test of EPAS for several reasons:

- It represents a realistic event--the composition of the supply of Army volunteers changes, such as might happen if there were a threat of combat or if youth employment or education opportunities changed.

- Since EPAS' ordered list is based on the forecasts of available supply this test changes a factor which could significantly affect EPAS operation.

- In a real-world environment, changes to the applicant supply predicted by the mission blocks would be detected by USAREC and corresponding adjustments made. No such adjustments will be made for the test.

First Scenario Measures of Effectiveness

Analysis of the results of the simulation will focus on several key measures:

- Foremost among the issues is whether or not EPAS was able to function without aborting, given the erroneous supply forecasts.

- If, and when, did EPAS recognize that a problem was occurring? Did EPAS generate information so that, in an operational environment, Army managers would have sufficient warning to establish alternative policies before the situation became critical?

- Was EPAS able to generate a viable allocation plan despite the lack of anticipated resources?

Table 3. Test Scenario One Distributions.

FY87 Actual Contract Counts

EDUC LVL	MALE I	MALE II	MALE IIIA	MALE IIIB	MALE IV	FEMALE I	FEMALE II	FEMALE IIIA	FEMALE IIIB	FEMALE IV	TOTAL
HSSR	906	11463	9456	10916	57	74	1163	1355	8	0	35398
HSDG	3150	21335	14097	21340	4844	582	4828	4574	5340	8	80098
NHSG	112	3375	5461	34	3	1	5	3	1	0	8995
TOT	4168	36173	29014	32290	4904	657	5996	5932	5349	8	124491

FY87 Actual Contract Distributions

EDUC LVL	MALE I	MALE II	MALE IIIA	MALE IIIB	MALE IV	FEMALE I	FEMALE II	FEMALE IIIA	FEMALE IIIB	FEMALE IV	TOTAL
HSSR	0.007	0.092	0.076	0.088	0.001	0.001	0.009	0.011	0.000	0.000	0.285
HSDG	0.025	0.171	0.113	0.171	0.039	0.005	0.039	0.037	0.043	0.000	0.643
NHSG	0.001	0.027	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072
TOT	0.033	0.290	0.233	0.259	0.040	0.006	0.048	0.048	0.043	0.000	1.000

FY87 Sample Contract Counts

EDUC LVL	MALE I	MALE II	MALE IIIA	MALE IIIB	MALE IV	FEMALE I	FEMALE II	FEMALE IIIA	FEMALE IIIB	FEMALE IV	TOTAL
HSSR	99	925	769	889	0	0	99	112	0	0	2893
HSDG	240	1687	1137	1726	382	22	400	358	434	0	6386
NHSG	0	274	447	0	0	0	0	0	0	0	721
TOT	339	2886	2353	2615	382	22	499	470	434	0	10000

FY87 Sample Contract Distributions

EDUC LVL	MALE I	MALE II	MALE IIIA	MALE IIIB	MALE IV	FEMALE I	FEMALE II	FEMALE IIIA	FEMALE IIIB	FEMALE IV	TOTAL
HSSR	0.010	0.092	0.077	0.089	0.000	0.000	0.010	0.011	0.000	0.000	0.104
HSDG	0.024	0.169	0.114	0.173	0.038	0.002	0.040	0.036	0.043	0.000	0.803
NHSG	0.000	0.027	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.093
TOT	0.034	0.288	0.236	0.262	0.038	0.002	0.050	0.047	0.043	0.000	1.000

Deviations Between Actual and Sample Distributions

EDUC LVL	MALE I	MALE II	MALE IIIA	MALE IIIB	MALE IV	FEMALE I	FEMALE II	FEMALE IIIA	FEMALE IIIB	FEMALE IV
HSSR	-0.003	0.000	-0.001	-0.001	0.001	0.001	0.001	0.000	0.000	0.000
HSDG	0.001	0.002	-0.001	-0.002	0.001	0.003	-0.001	0.001	0.000	0.000
NHSG	0.001	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000

First Scenario Results

The first scenario successfully executed all twelve iterations despite differences in supply forecasts (as used by the optimization procedures) and supply arrivals (as used by the sequential classification procedures). The simulations achieved 87% of the annual goal and 87% of the quality goal.

Note that the annual fill (87%) is the same for both the baseline and the first scenario, indicating that EPAS was able to redistribute the available supply to meet demand, despite the unexpected supply. In addition, the quality goal (87%) represents only a 6% drop, relative to the 10% drop in available quality.

Scenario 2: comparison to Current System

Issue: How does EPAS compare to the current operational system?

The NIH simulations generated for the Benefit/Cost analysis demonstrated that EPAS would generate results significantly better than those achieved in the current system without EPAS' optimal guidance. Because of time and funding constraints ARI decided to cancel this simulation scenario.

Scenario 3: New Weapon System

Issue: How well can the prototype adapt to changing circumstances such as international tensions, legislative mandates for changing force size, introduction of new weapons, etc.

Introduction

In many respects, the issues addressed by this question are similar to those in the first question (above). "Changing circumstances" such as defined here manifest themselves, eventually, in some form of policy-like limitation on the Army and, therefore, on the system. Legislative mandates for changing force size, for example, might be directly reflected by revised mission blocks; or they might be indirectly reflected by altered goals, such as different quality goals for individual MOS.

The ability of EPAS to adapt to such changes is directly dependent on its ability to parametrically define appropriate policies. To demonstrate EPAS' abilities in this regard, the next simulations was designed to emulate the introduction of a new weapon system.

Description of Third Test Scenario

Introduction of a new weapon system was simulated by defining an artificial MOS and introducing it into the simulation. The characteristics of the MOS are described in

Table 4.

Table 4. Test Scenario Three: MOS Characteristics.

MOS Name:	99Z
Annual Requirement:	500
Minimum Cut Score:	110
Quality Goal:	80% I-IIIA High School Diploma Required No Category IV
Gender Goal:	40% Female
School Plan:	MAY 50 JUN 50 JUL 100 AUG 150 SEP 150

The school seat plan was defined so that initial accessions into the artificial MOS will not be required until some point in the future relative to the first appearance of the MOS in the system.

All other parameters within the simulation remained the same as defined in the Baseline Scenario. For example, the quality goals for each MOS will remain the same even though a significant drop in applicant quality is being simulated.

Third Scenario Measures of Effectiveness

Analysis of the results of the simulation will focus on several key measures:

- Foremost among the issues is whether or not EPAS was able to function without aborting, given the newly introduced MOS.
- Was EPAS able to generate a viable allocation plan, i.e., on which met the requirements of all MOS, despite the addition of the new requirement?

Third Scenario Results

We ran this scenario in two parts: the first 6 iterations followed by the last 6. [EPAS is usually executed in two parts due to time and space restrictions. This approach also provides the ability to verify the system's performance on a partial run, without having to spend the resources on a full, 12-iteration simulation.] The third scenario successfully executed all twelve iterations.

However, before any output could be obtained and any reports after the second part, we lost our logon identifications. By the time system access was restored, the job's output had been deleted from the system's queue.

Fourth Scenario--Mobilization

The fourth scenario was to simulate the impact of a general mobilization on EPAS. Because of a lack of funds, ARI decided to cancel this scenario.

REFERENCES

Curtis, W. et al. "The FORECAST System master plan," FORECAST Development Office, Office of the Assistant Secretary of the Army, Manpower, and Resource Allocation, 1983.

Manganaris, A.G., and C.E. Phillips. (1985). "Delayed entry program--A policy analysis," ARI Technical Report 679. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A167 847)

Manganaris, A.G., and E.J. Schmitz. (1984). "Projecting attrition by military occupational specialty," ARI Technical Report 637. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A168 183)

Schmitz, E.J., and P. McWhite. (1986). "Evaluating the benefits and costs of the Enlisted Personnel Allocation System (EPAS)," ARI Technical Report 721. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A177 619)

Suffa, F. (1983). "Potential cost reductions through systems improvements in assignment and selection processes." Working Paper, GRC-PSO-831317-15. McLean, VA: General Research Corporation.

United States Army Recruiting Command (1987, July 21). New awards program tested. USAREC Recruiter Journal, pp. 1-2.

APPENDIX A
BASELINE DATA

TABLE B-1. Baseline Data Sources.

DATA REQUIREMENTS	DATA SOURCE	COMMENTS
Accession Limits	ELIM-COMPLIP simulation model a/o October 87	Maximum accessions which can be accepted in any single month. [See Table B-2 for initial data values.]
MOS Training Requirements	FY 87 accessions	Total annual accession requirement for each entry level MOS (See Table B-7).
Simulated Applicant Stream	FY 87 contract population	Table B-3 contains demographic distributions for the FY 87 contract population. Used to generate random sample.
MOS Cluster Definitions	GRC-defined MOS cluster groupings	MOS clusters generated based on analysis of MOS requirements. [See Table B-4 for a list of the MOS cluster definitions.]
Mission Blocks	Based on FY 87 actuals	Initial USAREC Mission Blocks, i.e., those as of the beginning of the fiscal year. [See Table B-5.]
MOS Quality Goals	FY 87 accessions	The annual quality goals, gender goals, etc. for each MOS [See Table B-7.]
School Seat Plan	Based on FY 87 accessions	The training program as of the beginning of the fiscal year. This plan will include both the number of seats in a class and the initial entry DEP, i.e., the number of contracts DEPed from FY 86 into FY 87 schools.
Supply Groups Definitions	FY 86 contract population	Prior research used statistical clustering techniques on the FY 86 contract population by demographic category to generate supply groups for that specific category. [See Table B-6.]

TABLE B-2. Monthly Accession Limits.

MONTH	FY86	FY87	FY88
OCT	12178	15591	9947
NOV	11563	11830	10785
DEC	4885	5349	5969
JAN	13192	9140	11505
FEB	11530	8829	8868
MAR	8607	7313	11906
APR	7583	8040	8217
MAY	8228	7664	7287
JUN	7628	7121	10510
JUL	15286	13284	12707
AUG	13354	12345	11026
SEP	12263	13918	9076
TOT	126,297	120,424	117,803

TABLE B-3. FY87 DEMOGRAPHIC DISTRIBUTIONS.

FY87 Actual Contract Counts

EDUC	MALE					FEMALE					
LVL	I	II	IIIA	IIIB	IV	I	II	IIIA	IIIB	IV	TOTAL
HSSR	906	11463	9456	10916	57	74	1163	1355	8	0	35398
HSDG	3150	21335	14097	21340	4844	582	4828	4574	5340	8	80098
NHSG	112	3375	5461	34	3	1	5	3	1	0	8995
TOT	4168	36173	29014	32290	4904	657	5996	5932	5349	8	124491

FY87 Actual Contract Distributions

EDUC	MALE					FEMALE					
LVL	I	II	IIIA	IIIB	IV	I	II	IIIA	IIIB	IV	TOTAL
HSSR	0.007	0.092	0.076	0.088	0.001	0.001	0.009	0.011	0.000	0.000	0.285
HSDG	0.025	0.171	0.113	0.171	0.039	0.005	0.039	0.037	0.043	0.000	0.643
NHSG	0.001	0.027	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072
TOT	0.033	0.290	0.233	0.259	0.040	0.006	0.048	0.048	0.043	0.000	1.000

FY87 Sample Contract Counts

EDUC	MALE					FEMALE					
LVL	I	II	IIIA	IIIB	IV	I	II	IIIA	IIIB	IV	TOTAL
HSSR	99	925	769	889	0	0	99	112	0	0	2893
HSDG	240	1687	1137	1726	382	22	400	358	434	0	6386
NHSG	0	274	447	0	0	0	0	0	0	0	721
TOT	339	2886	2353	2615	382	22	499	470	434	0	10000

FY87 Sample Contract Distributions

EDUC	MALE					FEMALE					
LVL	I	II	IIIA	IIIB	IV	I	II	IIIA	IIIB	IV	TOTAL
HSSR	0.010	0.092	0.077	0.089	0.000	0.000	0.010	0.011	0.000	0.000	0.104
HSDG	0.024	0.169	0.114	0.173	0.038	0.002	0.040	0.036	0.043	0.000	0.803
NHSG	0.000	0.027	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.093
TOT	0.034	0.288	0.236	0.262	0.038	0.002	0.050	0.047	0.043	0.000	1.000

Deviations Between Actual and Sample Distributions

EDUC	MALE					FEMALE				
LVL	I	II	IIIA	IIIB	IV	I	II	IIIA	IIIB	IV
HSSR	-0.003	0.000	-0.001	-0.001	0.001	0.001	0.001	0.000	0.000	0.000
HSDG	0.001	0.002	-0.001	-0.002	0.001	0.003	-0.001	0.001	0.000	0.000
NHSG	0.001	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE B-4. MOS Cluster Definitions.

CLUSTER NUMBER	MOS	MOS DEFINITION
1	29E	COMMUNICATIONS ELECTRONICS RADIO REPAIRER
	29F	FIXED COMSEC EQUIPMENT REPAIRER
	29J	TELETYPEWRITER EQUIPMENT REPAIRER
	29V	STRATEGIC MICROWAVE SYSTEMS REPAIRER
	36L	AUTOMATIC SWITCHING SYSTEMS OPERATOR/MAINTAINER
2	29S	FIELD COMSEC EQUIPMENT REPAIRER
	39C	TARGET ACQUISITION SURVEILLANCE RADAR REPAIRER
3	29Y	SATELLITE COMMUNICATIONS EQUIPMENT REPAIRER
	35H	CALIBRATION SPECIALIST
4	29G	DIGITAL COMMUNICATIONS EQUIPMENT REPAIRER
	39T	TACTICAL COMPUTER SYSTEM REPAIRER
	93D	AIR TRAFFIC CONTROL SYSTEMS/EQUIPMENT REPAIRER
	24C	HAWK FIRING SECTION MECHANIC
	24G	HAWK COORDINATION CENTRAL MECHANIC
	24U	NIKE-HERCULES CUSTODIAL MECHANIC
5	96H	AERIAL INTELLIGENCE SPECIALIST
	05D	EW/SIGINT EMITTER IDENTIFIER/LOCATOR
6	05H	EW/SIGINT MORSE INTERCEPTOR - IMC
	05K	EW/SIGINT NON-MORSE INTERCEPTOR
	96D	IMAGERY ANALYST
	97G	COUNTER-SIGNALS INTELLIGENCE SPECIALIST
	98G	EW/SIGINT VOICE INTERCEPTOR
7	91P	X-RAY SPECIALIST
	91R	VETERINARY FOOD INSPECTION SPECIALIST
8	96F	PSYCHOLOGICAL OPERATIONS SPECIALIST
	98C	EW/SIGINT ANALYST
	98J	EW/SIGINT NONCOMMUNICATIONS INTERCEPTOR
	71Q	JOURNALIST
	71R	BROADCAST JOURNALIST
9	33P	EW/INTERCEPT STRATEGIC RECEIVING SUBSYSTEMS REP
	33Q	EW/INTERCEPT STRATEGIC PROCESS & STORAGE SYS REP
	33R	EW/INTERCEPT AVIATION SYSTEM REPAIRER
	33T	EW/INTERCEPT TACTICAL SYSTEM REPAIRER
10	76X	SUBSISTENCE SUPPLY SPECIALIST
	76P	MATERIEL CONTROL & ACCOUNTING SPECIALIST
	76V	MATERIEL STORAGE & HANDLING SPECIALIST
	77F	PETROLEUM SUPPLY SPECIALIST

TABLE B-4. MOS Cluster Definitions (continued).

CLUSTER NUMBER	MOS	MOS DEFINITION
11	71G	PATIENT ADMINISTRATION SPECIALIST
	76J	MEDICAL SUPPLY SPECIALIST
	71L	ADMINISTRATIVE SPECIALIST
	71M	CHAPEL ACTIVITIES SPECIALIST
	73C	FINANCE SPECIALIST
	75B	PERSONNEL ADMINISTRATION SPECIALIST
	75C	PERSONNEL MANAGEMENT SPECIALIST
	75D	PERSONNEL RECORDS SPECIALIST
	75E	PERSONNEL ACTIONS SPECIALIST
	76C	EQUIPMENT RECORDS & PARTS SPECIALIST
	76Y	UNIT SUPPLY SPECIALIST
	88N	TRAFFIC MANAGEMENT COORDINATOR
12	21G	PERSHING ELECTRONICS MATERIEL SPECIALIST
	24L	HAWK LAUNCHER/MECHANICAL SYSTEMS REPAIRER
	27B	LAND COMBAT SUPPORT SYSTEM TEST SPEC./LANCE REP
	27E	TOW/DRAGON REPAIRER
	27G	CHAPARRAL/REDEYE REPAIRER
	31L	WIRE SYSTEMS INSTALLER
	31V	UL COMMUNICATIONS MAINTENANCE REPAIRER
	35K	AVIONIC MECHANIC
	39E	SPECIAL ELECTRONICS DEVICES REPAIRER
	41E	AUDIO-VISUAL EQUIPMENT REPAIRER
	45G	FIRE CONTROL SYSTEMS REPAIRER
	26T	RADIO/TELEVISION SYSTEMS SPECIALIST
	27L	LANCE SYSTEM REPAIRER
	27M	MLRS REPAIRER
13	31M	MULTICHANNEL COMMUNICATIONS EQUIPMENT OPERATOR
	31N	TACTICAL CIRCUIT CONTROLLER
	93F	FIELD ARTILLERY METEOROLOGICAL CREW MEMBER
14	27F	VULCAN REPAIRER
	29M	TACTICAL SATELLITE/MICROWAVE REPAIRER
	35L	AVIONIC COMMUNICATIONS EQUIPMENT REPAIRER
	35M	AVIONIC NAVIGATION AND FLIGHT CONTROL EQUIP REP
	35R	AVIONIC SPECIAL EQUIPMENT REPAIRER
	36M	SWITCHING SYSTEMS OPERATOR
	55G	NUCLEAR WEAPONS SPECIALIST
15	24E	HAWK FIRE CONTROL MECHANIC
	32D	COMMUNICATIONS SYSTEMS CIRCUIT CONTROLLER
	46N	PERSHING ELECTRICAL-MECHANICAL REPAIRER

TABLE B-4. MOS Cluster Definitions (continued).

CLUSTER NUMBER	MOS	MOS DEFINITION
16	21L	PERSHING ELECTRONICS REPAIRER
	24H	HAWK FIRE CONTROL REPAIRER
	24J	HAWK PULSE RADAR REPAIRER
	24K	HAWK CONTINOUS WAVE RADAR REPAIRER
	26F	AERIAL PHOTOACTIVE SENSOR REPAIRER
	27N	FORWARD AREA ALERTING RADAR (FAAR) REPAIRER
	39B	AUTOMATIC TEST EQUIPMENT OPERATOR/MAINTAINER
	35G	BIOMEDICAL EQUIPMENT SPECIALIST, BASIC
	39D	DAS3 COMPUTER SYSTEM REPAIRER
	39L	FIELD ARTILLERY DIGITAL SYSTEMS REPAIRER
	39Y	FIELD ARTILLERY TACTICAL FIRE DIRECTION REPAIRER
17	43M	FABRIC REPAIR SPECIALIST
	57E	LAUNDRY & BATH SPECIALIST
18	51M	FIRE FIGHTER
	57F	GRAVES REGISTRATION SPECIALIST
	43E	PARACHUTE RIGGER
	88H	CARGO SPECIALIST
19	41J	OFFICE MACHINE REPAIRER
	45B	SMALL ARMS REPAIRER
	41C	FIRE CONTROL INSTRUMENT REPAIRER
	55B	AMMUNITION SPECIALIST
	68M	AIRCRAFT WEAPONS SYSTEMS REPAIRER
20	44B	METAL WORKER
	51B	CARPENTRY & MASONRY SPECIALIST
	51C	STRUCTURES SPECIALIST
	62E	HEAVY CONSTRUCTION EQUIPMENT OPERATOR
	62F	CRANE OPERATOR
	62H	CONCRETE & ASPHALT EQUIPMENT OPERATOR
	62J	GENERAL CONSTRUCTION EQUIPMENT OPERATOR
	62G	QUARRYING SPECIALIST
	77W	WATER TREATMENT SPECIALIST
21	42C	ORTHOTIC SPECIALIST
	42D	DENTAL LABORATORY SPECIALIST
	42E	OPTICAL LABORATORY SPECIALIST

TABLE B-4. MOS Cluster Definitions (continued).

CLUSTER NUMBER	MOS	MOS DEFINITION
22	51G	MATERIALS QUALITY SPECIALIST
	41B	TOPOGRAPHIC INSTRUMENT REPAIR SPECIALIST
	45K	TANK TURRET REPAIRER
	45L	ARTILLERY REPAIRER
	52C	UTILITIES EQUIPMENT REPAIRER
	52D	POWER GENERATOR EQUIPMENT REPAIRER
	52F	TURBINE ENGINE DRIVEN GENERATOR REPAIRER
	44E	MACHINIST
23	55D	EXPLOSIVE ORDNANCE DISPOSAL SPECIALIST
24	62B	CONSTRUCTION EQUIPMENT REPAIRER
	63B	LIGHT WHEEL VEHICLE MECHANIC
	63H	TRACK VEHICLE REPAIRER
	63J	QUARTERMASTER & CHEMICAL EQUIPMENT REPAIRER
	63W	WHEEL VEHICLE REPAIRER
25	88K	WATERCRAFT OPERATOR
26	68J	AIRCRAFT WEAPONS SYSTEM REPAIRER
	24T	PATRIOT SYSTEM MECHANIC
	63G	FUEL & ELECTRICAL SYSTEMS REPAIRER
	63S	HEAVY WHEEL VEHICLE MECHANIC
	63Y	TRACK VEHICLE MECHANIC
	67H	OBSERVATION AIRPLANE REPAIRER
	67N	UTILITY HELICOPTER REPAIRER
	67R	ATTACK HELICOPTER REPAIRER
	67S	SCOUT HELICOPTER REPAIRER
	67T	TACTICAL TRANPORT HELICOPTER REPAIRER
	67U	MEDIUM HELICOPTER REPAIRER
	67Y	ATTACK HELICOPTER REPAIRER
	68B	AIRCRAFT POWERPLANT REPAIRER
	68D	AIRCRAFT POWERTRAIN REPAIRER
	68F	AIRCRAFT ELECTRICIAN
	68G	AIRCRAFT STRUCTURAL REPAIRER
	68H	AIRCRAFT PNEUDRAULICS REPAIRER
	88L	WATERCRAFT ENGINEER
27	88M	MOTOR TRANSPORT OPERATOR
	94B	FOOD SERVICE SPECIALIST
28	13N	LANCE CREWMEMBER
	15E	PERSHING MISSILE CREW MEMBER
	25L	AN/TSQ-73 ADA COMMAND & CONTROL SYS OP/REP
	16H	ADA OPERATIONS & INTELLIGENCE ASSISTANT

TABLE B-4. MOS Cluster Definitions (continued).

CLUSTER NUMBER	MOS	MOS DEFINITION
29	94F	HOSPITAL FOOD SERVICE SPECIALIST
30	31K	COMBAT SIGNALER
	72E	TELECOMMUNICATIONS CENTER OPERATOR
	72G	AUTOMATIC DATA TELECOMMUNICATIONS OPERATOR
31	31C	SINGLE CHANNEL RADIO OPERATOR
	31Q	TACTICAL SATELLITE MICROWAVE SYSTEMS OPERATOR
32	81C	CARTOGRAPHER
	83E	PHOTO & LAYOUT SPECIALIST
	83F	PRINTING AND BINDERY SPECIALIST
33	01H	BIOLOGICAL SCIENCES ASSISTANT
	91A	MEDICAL SPECIALIST
	91C	PRACTICAL NURSE
	91D	OPERATING ROOM SPECIALIST
	91E	DENTAL SPECIALIST
	91F	PSYCHIATRIC SPECIALIST
	91H	ORTHOPEDIC SPECIALIST
	91J	PHYSICAL THERAPY SPECIALIST
	91L	OCCUPATIONAL THERAPY SPECIALIST
	91N	CARDIAC SPECIALIST
	91Q	PHARMACY SPECIALIST
	91S	PREVENTIVE MEDICINE SPECIALIST
	91T	ANIMAL SPECIALIST
	91U	EAR, NOSE, & THROAT (ENT) SPECIALIST
	91V	RESPIRATORY SPECIALIST
	91Y	EYE SPECIALIST
	92B	MEDICAL LABORATORY SPECIALIST
34	54B	CHEMICAL OPERATIONS SPECIALIST
	77L	PETROLEUM LABORATORY SPECIALIST
	81B	TECHNICAL DRAFTING SPECIALIST
	82B	CONSTRUCTION SURVEYOR
	82D	TOPOGRAPHIC SURVEYOR
	84B	STILL PHOTOGRAPHIC SPECIALIST
	93P	FLIGHT OPERATIONS COORDINATOR
35	33V	EW/INTERCEPT AERIAL SENSOR REPAIRER
	93B	AEROSCOUT OBSERVER
	93H	AIR TRAFFIC CONTROL TOWER OPERATOR
	93J	AIR TRAFFIC CONTROL RADAR CONTROLLER
36	74D	COMPUTER/MACHINE OPERATOR
	74F	PROGRAMMER/ANALYST
	73D	ACCOUNTING SPECIALIST

TABLE B-4. MOS Cluster Definitions (continued).

CLUSTER NUMBER	MOS	MOS DEFINITION
37	95B	MILITARY POLICE
38	97E	INTERROGATOR
39	96B	INTELLIGENCE ANALYST
	91G	BEHAVIORAL SCIENCE SPECIALIST
	97B	COUNTERINTELLIGENCE AGENT
40	75F	PERSONNEL INFORMATION SYSTEMS MANAGEMENT SPEC
	71D	LEGAL SPECIALIST
41	29N	TELEPHONE CENTRAL OFFICE REPAIRER
42	81E	ILLUSTRATOR
	84F	AUDIO/TELEVISION SPECIALIST
43	81Q	TERRAIN ANALYST
	55R	AMMUNITION STOCK CONTROL & ACCOUNTING SPECIALIST
44	96R	GROUND SURVEILLANCE SYSTEMS OPERATOR
45	24M	VULCAN SYSTEM MECHANIC
	24N	CHAPARRAL SYSTEM MECHANIC
46	11X	INFANTRY
	12C	BRIDGE CREWMAN
	12F	ENGINEER TRACKED VEHICLE CREWMAN
	19E	M48-M60 ARMOR CREWMAN
	19K	M1 ABRAMS CREWMAN
	19D	CAVALRY SCOUT
47	51R	INTERIOR ELECTRICIAN
	52G	TRANSMISSION & DISTRIBUTION SPECIALIST
48	13B	CANNON CREWMAN
49	15J	MLRS/LANCE OPERATIONAL/FIRE DIRECTION SPECIALIST
	13F	FIRE SUPPORT SPECIALIST
50	51K	PLUMBER
51	45T	M2/BRADLEY FIGHTING VEHICLE SYSTEM TURRET MECH
	54C	SMOKE OPERATIONS SPECIALIST
	45D	SELF-PROPELLED FIELD ARTILLERY TURRET MECHANIC

TABLE B-4. MOS Cluster Definitions (continued).

CLUSTER NUMBER	MOS	MOS DEFINITION
52	45E	M1 ABRAMS TANK TURRET MECHANIC
	45N	M60A1/A3 TANK TURRET MECHANIC
	63E	M1 ABRAMS TANK SYSTEMS MECHANIC
	63N	M60A1/A3 TANK SYSTEM MECHANIC
53	63D	SELF-PROPELLED FIELD ARTILLERY SYSTEM MECHANIC
	63T	BFV SYSTEM MECHANIC
54	16S	MANPADS (MAN PORTABLE AIR DEFENSE SYSTEM) CREWMAN
55	16P	AIR DEFENSE ARTILLERY CHAPARRAL MISSILECREWMAN
	16R	VULCAN CREWMEMBER
	16X	AIR CREWMEMBER
	16J	DEFENSE ACQUISITION RADAR OPERATOR
56	13M	MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) CREWMEMBER
57	13R	FA FIREFINDER RADAR OPERATOR
58	13C	TACFIRE OPERATIONS SPECIALIST
	13E	CANNON FIRE DIRECTION SPECIALIST
	82C	FIELD ARTILLERY SURVEYOR

TABLE B-5. FY87 Initial Mission Blocks.

MALE

EDUCATION LEVEL	AFQT CATEGORY I	II	IIIA	IIIB	IV	TOTAL
Non-Grad	94	3010	4813	3	0	7920
Graduate	3332	24164	16788	24450	4125	72859
Senior	418	5410	4404	3630	0	13862
TOTAL	3844	32584	26005	28083	4125	94641

FEMALE

EDUCATION LEVEL	AFQT CATEGORY I	II	IIIA	IIIB	IV	TOTAL
Non-Grad	0	0	0	0	0	0
Graduate	540	4680	4575	4544	0	14339
Senior	31	543	589	0	0	1163
TOTAL	571	5223	5164	4544	0	15502

TABLE B-6. Supply Group Definitions.

GROUP NBR	MISSION SIZE	POP. PCT	AVERAGE APTITUDE AREA SCORES CL	CO	EL	FA	GM	MM	OF	SC	ST
			Male, Non-High School Graduates, AFQT I-II								
1	2352	55.4	113	117	114	113	113	116	117	118	114
2	1313	31.0	121	128	125	123	126	127	125	128	124
3	576	13.6	109	107	104	108	99	103	107	107	105
	4,241	100.0									
			Male, Non-High School Graduates, AFQT IIIA								
4	638	9.0	99	96	93	96	88	94	98	96	93
5	2845	39.9	102	107	101	103	101	106	108	108	102
6	2030	28.5	105	114	108	107	110	114	113	115	109
7	1614	22.6	109	119	115	112	120	120	117	120	115
	7,127	100.0									
			Male, Non-High School Graduates, AFQT IIIB								
8	542	100.0	99	107	100	101	102	106	106	106	101
			Male, Non-High School Graduates, AFQT IV								
9	10	100.0	86	95	91	90	95	98	96	93	90

TABLE B-6. Supply Group Definitions (continued).

GROUP NBR	MISSION SIZE	POP. PCT	AVERAGE APTITUDE AREA SCORES CL	CO	EL	FA	GM	MM	OF	SC	ST
			Male, High School Graduates, AFQT I-II								
10	1239	3.9	109	102	103	105	97	99	104	103	103
11	1649	5.2	116	109	111	114	105	104	107	108	111
12	1091	3.4	109	114	104	110	103	110	114	113	107
13	1323	4.2	122	113	119	121	112	106	109	112	118
14	1823	5.8	115	111	115	111	114	112	113	113	115
15	1148	3.6	108	118	108	111	111	118	119	118	109
16	2172	6.9	119	119	117	120	114	114	116	119	118
17	1250	3.9	111	126	111	117	113	123	123	123	112
18	2160	6.8	125	122	124	127	119	116	118	121	125
19	2827	8.9	130	135	135	134	137	135	132	134	133
20	2091	6.6	128	124	131	128	128	121	120	124	129
21	1898	6.0	123	128	124	127	124	124	124	126	124
22	1848	5.8	119	123	120	121	121	122	121	122	120
23	1865	5.9	113	118	118	112	121	122	120	121	117
24	715	2.3	124	114	127	119	124	115	114	118	124
25	2272	7.2	129	130	132	131	132	127	126	129	131
26	2683	8.5	117	127	122	120	126	128	126	128	122
27	1620	5.1	123	131	128	127	131	132	129	130	127
	32,226	300.0									
			Male, High School Graduates, AFQT IIIA								
28	1319	6.6	100	95	94	97	89	93	98	95	95
29	1015	5.1	109	102	102	109	94	95	98	99	101
30	1965	9.8	103	109	99	107	98	105	107	106	100
31	756	3.8	117	126	124	122	129	125	120	125	123
32	1987	9.9	115	115	118	118	116	112	110	114	116
33	1309	6.6	103	98	103	98	102	101	102	101	102
34	3277	16.4	109	121	115	113	120	122	119	120	115
35	1300	6.5	111	105	111	110	106	102	103	105	110
36	2029	10.2	101	110	102	101	106	111	112	111	104
37	1533	7.7	106	108	112	102	116	113	111	112	112
38	3475	17.4	105	116	106	110	109	115	115	114	108
	19,965	100.0									

TABLE B-6. Supply Group Definitions (continued).

GROUP NBR	MISSION SIZE	POP. PCT	AVERAGE APTITUDE AREA SCORES CL	CO	EL	FA	GM	MM	OF	SC	ST
			Male, Hight School Graduates, AFQT IIIB								
39	590	2.0	109	110	115	113	115	109	104	108	112
40	1634	5.6	104	119	110	111	116	118	113	116	110
41	2636	9.1	90	87	88	87	87	89	91	88	89
42	1258	4.4	103	104	106	104	108	104	103	104	108
43	2330	8.0	99	99	102	100	101	99	98	99	101
44	1060	3.7	87	90	80	90	76	87	90	85	80
45	1747	6.0	97	92	99	95	96	92	92	92	96
46	861	3.0	101	112	100	110	98	105	103	104	98
47	3061	10.6	92	96	89	98	85	92	92	89	87
48	2452	8.5	94	104	97	95	105	108	107	106	101
49	1680	5.8	88	96	87	89	91	99	99	95	89
50	3304	11.4	94	104	92	102	91	100	100	99	93
51	1544	5.3	91	113	96	100	104	115	112	109	98
52	1853	6.4	90	100	93	91	98	104	103	100	94
53	1216	4.2	97	111	106	100	116	117	113	113	108
54	1750	6.0	98	111	102	104	107	111	108	109	102
	28,976	100.0									
			Male, High School Graduates, AFQT IV								
55	1609	29.1	89	105	95	97	102	106	101	101	95
56	1878	33.9	86	89	85	90	83	88	87	84	83
57	2050	37.0	86	97	88	92	91	97	95	93	89
	5,537	100.0									

TABLE B-6. Supply Group Definitions (continued).

GROUP NBR	MISSION SIZE	POP. PCT	AVERAGE APTITUDE AREA SCORES CL	CO	EL	FA	GM	MM	OF	SC	ST
			Male, High School Seniors, AFQT I-II								
58	2675	64.8	118	118	119	119	117	116	117	118	119
59	868	21.0	127	128	130	129	130	127	125	128	130
60	584	14.2	111	107	106	109	101	103	108	107	107
	4,127	100.0									
			Male, High School Seniors, AFQT IIIA								
61	2349	71.0	109	113	112	111	113	113	112	113	112
62	960	29.0	103	101	100	102	97	99	103	101	101
	3,309	100.0									
			Male, High School Seniors, AFQT IIIB								
63	1071	30.3	92	92	90	92	88	92	93	90	91
64	2465	69.7	98	106	102	102	105	106	105	105	103
	3,536	100.0									
			Male, High School Seniors, AFQT IV								
65	110	64.3	89	100	94	95	98	102	99	98	95
66	61	35.7	88	89	86	90	84	85	86	86	86
	171	100.0									

TABLE B-6. Supply Group Definitions (continued).

GROUP NBR	MISSION SIZE	POP. PCT	AVERAGE APTITUDE AREA SCORES CL	CO	EL	FA	GM	MM	OF	SC	ST
			Female, High School Graduates, AFQT I-II								
67	1942	32.2	112	106	105	111	98	99	105	105	106
68	1861	30.9	125	121	124	126	118	115	117	119	124
69	1759	29.2	117	113	113	117	107	106	111	111	114
70	464	7.7	108	96	98	102	89	90	98	96	99
	6,026	100.0									
			Female, High School Graduates, AFQT IIIA								
71	2262	44.1	104	100	98	104	93	95	100	98	100
72	1407	27.4	100	92	92	97	85	87	94	91	92
73	1460	28.5	108	108	106	111	103	104	106	105	108
	5,129	100.0									
			Female, High School Graduates, AFQT IIIA								
74	2046	39.4	93	87	89	92	84	85	89	85	89
75	2029	39.0	94	97	89	99	85	91	94	90	91
76	1125	21.6	100	101	99	105	96	97	98	96	100
	5,200	100.0									
			Female, High School Graduates, AFQT IIIB								
77	100	100.0	88	90	86	93	84	87	88	84	86

TABLE B-6. Supply Group Definitions (continued).

GROUP NBR	MISSION SIZE	POP. PCT	AVERAGE APTITUDE AREA SCORES CL	CO	EL	FA	GM	MM	OF	SC	ST
			Female, High School Seniors, AFQT I-II								
78	408	100.0	117	110	112	117	105	103	108	108	113
			Female, High School Seniors, AFQT IIIA								
79	405	100.0	105	100	100	105	95	95	100	98	102
			Female, High School Seniors, AFQT IIIB								
80	59	100.0	98	95	95	100	90	91	95	92	96
			Female, High School Seniors, AFQT IV								
81	8	100.0	93	89	90	93	86	87	89	86	89

TABLE A-7. MOS Training Requirements

MOS	MALE						FEMALE						TOTAL ANNUAL DEMAND
	HIGH SCHOOL GRAD			NON GRAD			HIGH SCHOOL GRAD			NON GRAD			
	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	
01E	35	2	1	0	0	0	13	1	0	0	0	0	52
05D	39	14	0	0	0	0	17	3	0	0	0	0	73
05H	250	34	1	0	0	0	57	7	0	0	0	0	349
05K	115	7	0	0	0	0	70	2	0	0	0	0	194
11X	10981	5388	1031	2465	11	1	0	1	0	0	0	0	19878
12B	1558	834	137	247	0	0	0	0	0	0	0	0	2776
12C	233	167	36	32	1	0	0	0	0	0	0	0	469
12F	75	56	11	12	0	0	0	0	0	0	0	0	154
13B	2812	2593	834	633	3	1	0	0	0	0	0	0	6876
13C	90	51	4	17	0	0	0	0	0	0	0	0	162
13E	584	210	15	106	0	0	0	0	0	0	0	0	915
13F	935	311	38	392	0	0	0	0	0	0	0	0	1676
13M	213	140	15	20	1	0	0	0	0	0	0	0	389
13N	175	65	8	76	1	0	0	0	0	0	0	0	325
13R	68	49	4	5	0	0	0	0	0	0	0	0	126
15E	301	86	13	61	0	0	94	21	0	0	0	0	576
15J	47	43	4	5	0	0	0	0	0	0	0	0	99
16H	84	35	1	17	0	0	11	6	0	0	0	0	154
16J	14	12	0	5	0	0	0	0	0	0	0	0	31
16P	68	26	4	13	0	0	0	0	0	0	0	0	111
16R	261	130	12	29	0	0	0	0	0	0	0	0	432
16S	273	384	81	188	0	0	0	0	0	0	0	0	926
16X	257	134	11	68	0	0	71	32	0	0	0	0	573
19D	944	407	85	116	1	0	0	0	0	0	0	0	1553
19E	383	365	92	123	0	0	0	0	0	0	0	0	963
19K	1242	418	91	193	0	0	0	0	0	0	0	0	1944
21G	41	21	1	5	0	0	6	2	0	0	0	0	76
21L	31	4	0	4	0	0	2	0	0	0	0	0	41
24C	74	8	0	6	0	0	6	0	0	0	0	0	94
24E	1	1	0	0	0	0	0	0	0	0	0	0	2
24G	80	9	0	7	0	0	4	0	0	0	0	0	100
24H	21	2	0	1	0	0	2	0	0	0	0	0	26
24J	10	1	0	1	0	0	1	0	0	0	0	0	13
24K	10	3	0	2	0	0	0	0	0	0	0	0	15
24L	7	4	0	2	0	0	2	1	0	0	0	0	16
24M	74	7	0	8	0	0	0	0	0	0	0	0	89
24N	28	2	0	3	0	0	0	0	0	0	0	0	33
24T	49	13	0	9	0	0	2	1	0	0	0	0	74
24U	10	4	0	1	0	0	0	1	0	0	0	0	16
25L	9	3	0	1	0	0	2	0	0	0	0	0	15
26F	1	0	0	1	0	0	0	0	0	0	0	0	2
26T	24	7	0	2	0	0	11	4	0	0	0	0	48
27B	23	11	0	6	0	0	2	1	0	0	0	0	43
27E	104	41	6	18	0	0	13	4	0	0	0	0	186
27F	28	11	0	3	0	0	2	0	0	0	0	0	44
27G	27	16	0	3	0	0	1	1	0	0	0	0	48
27L	6	3	0	2	0	0	1	0	0	0	0	0	12
27M	18	16	1	2	0	0	9	5	0	0	0	0	51
27N	29	2	0	3	0	0	3	0	0	0	0	0	37
29E	308	11	0	24	0	0	29	0	0	0	0	0	372
29F	212	9	0	12	0	0	16	0	0	0	0	0	249
29G	23	2	0	2	0	0	6	0	0	0	0	0	33
29J	104	9	0	18	0	0	21	1	0	0	0	0	153
29M	69	10	0	4	0	0	3	2	0	0	0	0	88
29N	121	23	0	0	0	0	20	1	0	0	0	0	165
29S	186	25	0	12	0	0	21	0	0	0	0	0	244

TABLE A-7. MOS Training Requirements (Continued).

MOS	MALE						FEMALE						TOTAL ANNUAL DEMAND
	HIGH SCHOOL GRAD			NON GRAD			HIGH SCHOOL GRAD			NON GRAD			
	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	
29V	78	4	0	0	0	0	6	0	0	0	0	0	88
29Y	128	0	0	7	0	0	4	0	0	0	0	0	139
31C	878	241	7	237	1	0	193	17	0	0	0	0	1574
31K	1149	592	95	172	0	0	140	84	1	0	0	0	2233
31L	221	105	10	79	0	0	82	118	0	0	0	0	615
31M	955	391	24	173	0	0	315	49	0	0	0	0	1907
31N	78	50	2	1	0	0	35	11	0	0	0	0	177
31Q	266	139	8	45	0	0	65	22	0	0	0	0	545
31V	818	295	19	132	1	0	98	43	0	0	0	0	1406
32D	187	45	0	11	0	0	59	2	0	0	0	0	304
33P	69	0	0	1	0	0	2	0	0	0	0	0	72
33Q	61	4	0	2	0	0	11	0	0	0	0	0	78
33R	67	1	0	1	0	0	3	0	0	0	0	0	72
33T	80	1	0	2	0	0	3	0	0	0	0	0	86
33V	12	0	0	0	0	0	0	0	0	0	0	0	12
35G	111	6	0	4	0	0	32	0	0	0	0	0	153
35H	87	1	0	6	0	0	8	0	0	0	0	0	102
35K	162	43	0	15	0	0	11	9	0	0	0	0	240
35L	113	22	0	5	0	0	15	0	0	0	0	0	155
35M	47	6	1	5	0	0	9	4	0	0	0	0	72
35R	102	29	1	6	0	0	12	0	0	0	0	0	150
36L	63	3	0	9	0	0	6	0	0	0	0	0	81
36M	104	35	2	19	0	0	113	14	0	0	0	0	287
39B	53	3	0	2	0	0	13	0	0	0	0	0	71
39C	30	0	0	2	0	0	3	0	0	0	0	0	35
39D	53	8	0	0	0	0	3	0	0	0	0	0	64
39E	47	26	0	3	0	0	14	4	0	0	0	0	94
39L	14	0	0	0	0	0	1	0	0	0	0	0	15
39T	33	3	0	2	0	0	4	0	0	0	0	0	42
39Y	24	1	0	3	0	0	0	0	0	0	0	0	28
41B	3	5	0	1	0	0	5	2	0	0	0	0	16
41C	37	40	4	10	0	0	7	7	0	0	0	0	105
41E	0	0	0	1	0	0	1	0	0	0	0	0	2
41J	0	1	0	0	0	0	1	0	0	0	0	0	2
42C	11	3	0	1	0	0	9	0	0	0	0	0	24
42D	50	13	0	3	0	0	9	2	0	0	0	0	77
42E	17	6	2	2	0	0	14	1	0	0	0	0	42
43E	252	272	29	171	0	0	68	22	0	0	0	0	814
43M	5	22	1	3	0	0	0	8	0	0	0	0	39
44B	109	143	8	33	0	0	2	2	0	0	0	0	297
44E	107	60	4	8	0	0	1	0	0	0	0	0	180
45B	72	87	3	9	2	0	0	0	0	0	0	0	173
45D	40	49	8	9	0	0	0	0	0	0	0	0	106
45E	87	73	13	11	1	0	0	0	0	0	0	0	185
45G	18	17	0	5	0	0	0	3	0	0	0	0	43
45K	162	80	9	24	0	0	17	0	0	0	0	0	292
45L	44	25	3	7	0	0	11	1	0	0	0	0	91
45N	28	14	0	10	0	0	0	0	0	0	0	0	52
45T	37	46	6	21	0	0	0	0	0	0	0	0	110
46N	6	4	0	4	0	0	1	0	0	0	0	0	15
51B	289	261	34	50	3	0	7	6	0	0	0	0	650
51C	7	2	1	0	0	0	0	0	0	0	0	0	10
51G	5	2	0	1	0	0	3	0	0	0	0	0	11
51K	75	56	9	20	0	0	0	1	0	0	0	0	161
51M	40	20	3	6	0	0	0	0	0	0	0	0	69
51R	138	47	2	14	0	0	0	0	0	0	0	0	201

TABLE A-7. MOS Training Requirements (Continued).

MOS	MALE						FEMALE						TOTAL ANNUAL DEMAND
	HIGH SCHOOL GRAD			NON GRAD			HIGH SCHOOL GRAD			NON GRAD			
	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	
52C	215	186	14	42	0	0	35	20	0	0	0	0	512
52D	872	671	94	162	0	0	138	12	0	0	0	0	1949
52F	5	4	0	0	0	0	0	0	0	0	0	0	9
52G	6	10	0	2	0	0	0	0	0	0	0	0	18
54B	582	320	25	204	0	0	93	39	0	0	0	0	1263
54C	94	49	9	85	0	1	0	0	0	0	0	0	238
55B	348	144	39	78	1	0	86	29	0	0	0	0	725
55D	140	23	0	21	0	0	19	0	0	0	0	0	203
55G	42	19	3	3	0	0	17	2	0	0	0	0	86
55R	21	2	0	0	0	0	7	9	0	0	0	0	39
57E	4	44	8	35	0	0	2	20	0	0	0	0	113
57F	29	32	5	9	0	0	3	4	0	0	0	0	82
62B	307	230	32	53	0	0	8	30	0	0	0	0	660
62E	336	221	16	36	1	0	2	11	0	0	0	0	623
62F	83	68	21	17	0	0	4	10	1	0	0	0	204
62G	16	14	0	6	0	0	2	2	0	0	0	0	40
62H	6	13	4	7	0	0	1	2	0	0	0	0	33
62J	151	105	21	18	0	0	1	2	0	0	0	0	298
63B	1230	1136	159	184	1	0	190	276	2	1	0	0	3179
63D	224	177	20	57	0	0	0	0	0	0	0	0	478
63E	195	175	22	29	0	0	0	0	0	0	0	0	421
63G	105	60	5	20	0	0	8	4	0	0	0	0	202
63H	321	303	83	49	2	0	33	56	0	0	0	0	847
63J	139	203	26	28	0	0	23	61	0	0	0	0	480
63N	115	30	1	22	0	0	0	0	0	0	0	0	168
63S	170	125	7	36	0	0	12	5	0	0	0	0	355
63T	763	481	51	80	1	0	0	0	0	0	0	0	1376
63W	266	353	64	49	0	0	23	52	0	0	0	0	807
63Y	168	81	12	31	0	0	10	4	0	0	0	0	306
67H	60	6	0	4	0	0	3	0	0	0	0	0	73
67N	379	96	3	33	0	0	8	3	0	0	0	0	522
67R	67	27	1	6	0	0	8	4	0	0	0	0	113
67S	9	2	0	5	0	0	0	0	0	0	0	0	16
67T	317	97	8	27	0	0	17	3	0	0	0	0	469
67U	305	91	6	33	0	0	4	0	0	0	0	0	439
67Y	295	56	0	31	0	0	2	0	0	0	0	0	384
68B	151	29	0	18	0	0	4	1	0	0	0	0	203
68D	96	29	1	12	0	0	1	0	0	0	0	0	139
68F	104	22	2	11	0	0	5	0	0	0	0	0	144
68G	123	37	3	21	0	0	4	0	0	0	0	0	188
68H	16	5	0	4	0	0	5	0	0	0	0	0	30
68J	191	64	2	23	1	0	11	1	0	0	0	0	293
68M	132	77	1	17	0	0	4	0	0	0	0	0	231
71D	300	2	0	0	0	0	124	1	0	0	0	0	427
71G	64	50	2	18	0	0	105	60	0	0	0	0	300
71L	827	218	3	115	0	0	1694	656	0	0	0	0	3513
71M	139	41	2	13	0	0	81	20	0	0	0	0	296
71Q	58	1	0	1	0	0	28	0	0	0	0	0	88
71R	24	2	0	0	0	0	8	0	0	0	0	0	34
72E	196	198	15	41	0	0	129	56	0	0	0	0	635
72G	168	93	0	16	0	0	160	107	0	0	0	0	544
73C	231	83	1	25	1	0	194	61	0	0	0	0	596
73D	47	0	0	2	0	0	44	1	0	0	0	0	94
74D	170	5	0	9	0	0	48	0	0	0	0	0	232
74F	189	17	1	6	0	0	67	10	0	0	0	0	290

TABLE A-7. MOS Training Requirements (Continued).

MOS	MALE						FEMALE						TOTAL ANNUAL DEMAND
	HIGH SCHOOL GRAD			NON GRAD			HIGH SCHOOL GRAD			NON GRAD			
	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	
75B	539	314	6	80	0	0	277	100	0	0	0	0	1316
75C	170	106	4	31	0	0	225	84	0	0	0	0	620
75D	112	57	3	15	0	0	267	114	0	0	0	0	568
75E	95	55	2	16	0	0	218	88	0	0	0	0	474
75F	125	21	1	0	0	0	110	10	0	0	0	0	267
76C	1367	510	19	141	0	0	215	62	1	0	0	0	2315
76J	70	69	3	13	0	0	93	84	0	0	0	0	332
76P	289	350	17	57	0	0	120	176	1	0	0	0	1010
76V	566	524	60	121	1	0	157	256	0	0	0	0	1685
76X	46	72	5	8	0	0	26	82	0	0	0	0	239
76Y	1645	971	42	320	0	0	623	146	0	0	0	0	3747
77F	1088	707	46	248	1	0	197	181	0	0	0	0	2468
77L	19	8	0	0	0	0	10	6	0	0	0	0	43
77W	20	22	4	13	0	0	13	15	0	0	0	0	87
81B	44	4	0	2	0	0	9	0	0	0	0	0	59
81C	9	2	0	1	0	0	6	4	0	0	0	0	22
81E	57	15	0	0	0	0	31	2	0	0	0	0	105
81Q	22	5	0	0	0	0	12	0	0	0	0	0	39
82B	39	16	0	3	0	0	8	0	0	0	0	0	66
82C	144	87	11	21	0	0	0	0	0	0	0	0	263
82D	10	2	0	1	0	0	3	1	0	0	0	0	17
83E	4	8	1	1	0	0	13	1	0	0	0	0	28
83F	8	22	4	3	0	0	3	5	0	0	0	0	45
84B	57	28	1	5	0	0	7	1	0	0	0	0	99
84F	25	6	0	0	0	0	23	2	0	0	0	0	56
88H	83	80	16	26	0	0	28	38	0	0	0	0	271
88K	73	38	2	13	0	0	13	12	0	0	0	0	151
88L	59	39	1	11	0	0	10	2	0	0	0	0	122
88M	945	865	131	260	2	0	240	416	3	0	0	0	2862
88N	148	70	1	28	0	0	128	41	0	0	0	0	416
91A	3313	1336	91	555	1	0	1191	151	0	0	0	0	6638
91C	28	3	0	0	0	0	154	15	0	0	0	0	200
91D	96	35	8	15	0	0	160	28	0	0	0	0	340
91E	150	80	6	15	1	0	218	51	0	0	0	0	521
91F	43	13	0	4	0	0	50	8	0	0	0	0	118
91G	48	9	0	0	0	0	103	0	0	0	0	0	160
91H	23	15	0	2	0	0	28	3	0	0	0	0	71
91J	44	2	0	1	0	0	16	1	0	0	0	0	64
91L	12	1	0	1	0	0	13	4	0	0	0	0	31
91N	14	2	0	0	0	0	14	2	0	0	0	0	32
91P	189	38	0	3	0	0	182	8	0	0	0	0	420
91Q	71	8	0	5	0	0	81	4	0	0	0	0	169
91R	86	19	1	11	0	0	56	15	0	0	0	0	188
91S	69	17	1	6	0	0	98	16	0	0	0	0	207
91T	46	9	2	4	0	0	51	8	1	0	0	0	121
91U	17	12	0	4	0	0	19	6	0	0	0	0	58
91V	8	1	0	0	0	0	5	0	0	0	0	0	14
91Y	38	11	0	2	0	0	44	9	0	0	0	0	104
92B	197	31	0	9	0	0	216	26	0	0	0	0	479
93B	530	142	1	42	0	0	20	2	0	0	0	0	737
93D	32	6	0	3	0	0	7	0	0	0	0	0	48
93F	37	45	6	11	0	0	12	8	0	0	0	0	119
93H	130	6	0	7	0	0	16	1	0	0	0	0	160
93J	40	2	1	2	0	0	8	0	0	0	0	0	53
93P	227	91	1	27	0	0	95	37	0	0	0	0	478

TABLE A-7. MOS Training Requirements (Continued).

	MALE						FEMALE						
	HIGH SCHOOL GRAD			NON GRAD			HIGH SCHOOL GRAD			NON GRAD			TOTAL ANNUAL
MOS	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	I-IIIA	IIIB	IV	DEMAND
94B	1312	1544	515	693	1	0	371	576	1	0	0	0	5013
95B	3097	840	26	173	0	0	745	217	1	0	0	0	5099
96B	301	10	0	0	0	0	110	2	0	0	0	0	423
96D	50	12	0	4	0	0	31	4	0	0	0	0	101
96F	13	0	0	2	0	0	22	0	0	0	0	0	37
96H	18	0	0	0	0	0	5	0	0	0	0	0	23
96R	138	52	0	23	0	0	0	0	0	0	0	0	213
97B	222	3	0	3	0	0	66	1	0	0	0	0	295
97E	111	0	0	0	0	0	77	2	0	0	0	0	190
97G	30	8	0	1	0	0	9	1	0	0	0	0	49
98C	202	3	0	5	0	0	104	1	0	0	0	0	315
98G	608	12	0	4	0	0	354	5	0	0	0	0	983
98J	118	10	0	11	0	0	25	1	0	0	0	0	165

APPENDIX B

FIELD TEST BRIEFING CHARTS

The charts contained in this appendix were those used to brief ARI on the final results of the EPAS project and the results of the Field Test.

Army Research Institute

EPAS

ENLISTED PERSONNEL ALLOCATION SYSTEM

General Research Corporation

ARI – SPONSORED RESEARCH

ENHANCED ALLOCATION SYSTEM

PROJECT A : Develop and validate improved selection and classification instruments and standards.

PROJECT B : Identify techniques for, and develop a prototype of, a computerized personnel allocation system.

ENLISTED PERSONNEL ALLOCATION SYSTEM (EPAS) :

"... build upon state-of-the-art in such areas as: differential classification of people/jobs, prediction of employee work behavior, optimization algorithms, methods of combining multiple objectives, and estimation of utility or pay-off equations..."

ENLISTED PERSONNEL ALLOCATION SYSTEM

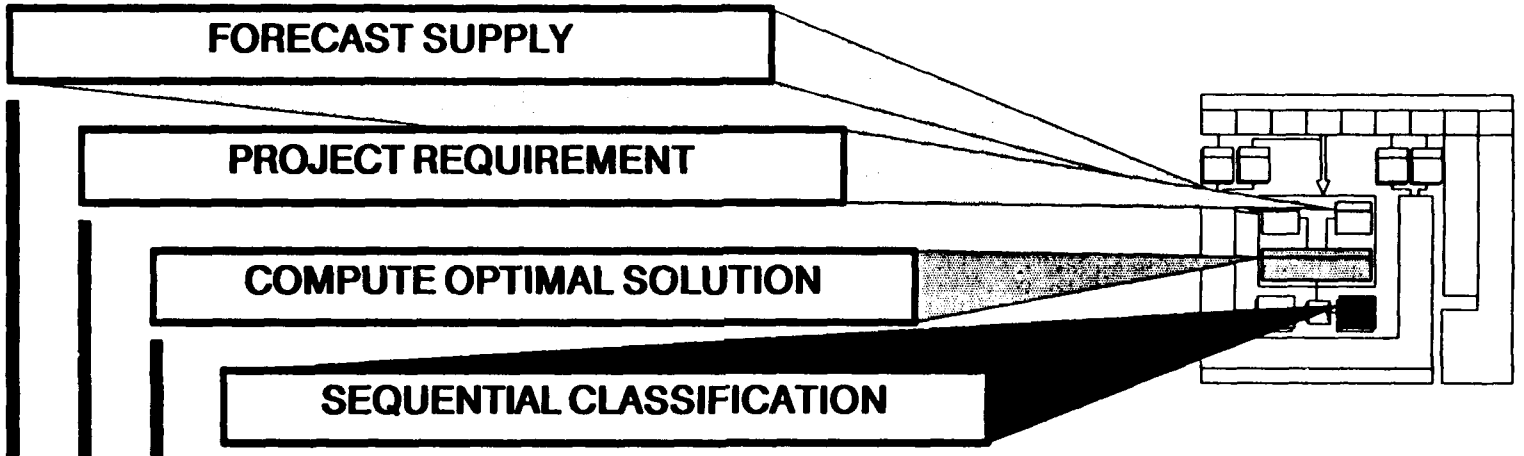
DEVELOPMENT PHASES

- **BASELINE PROTOTYPE**
  - Background Research
  - Selection of Methodology
  - Verification of Approach — 10 MOS Prototype, Wicat

- **FULL-SCALE PROTOTYPE**
  - Validation of Approach — Full Scale Prototype, NIH
  - Benefit / Cost Analysis
  - Policy Analyses

- **OPERATIONAL PROTOTYPE**
  - Usability of Approach — Operational Prototype, ISC-P
  - Enhancements to Optimization Formulation
  - Field Test

ENHANCED ALLOCATION SYSTEM
EPAS METHODOLOGY



New Projection Factors
Simulation Capability

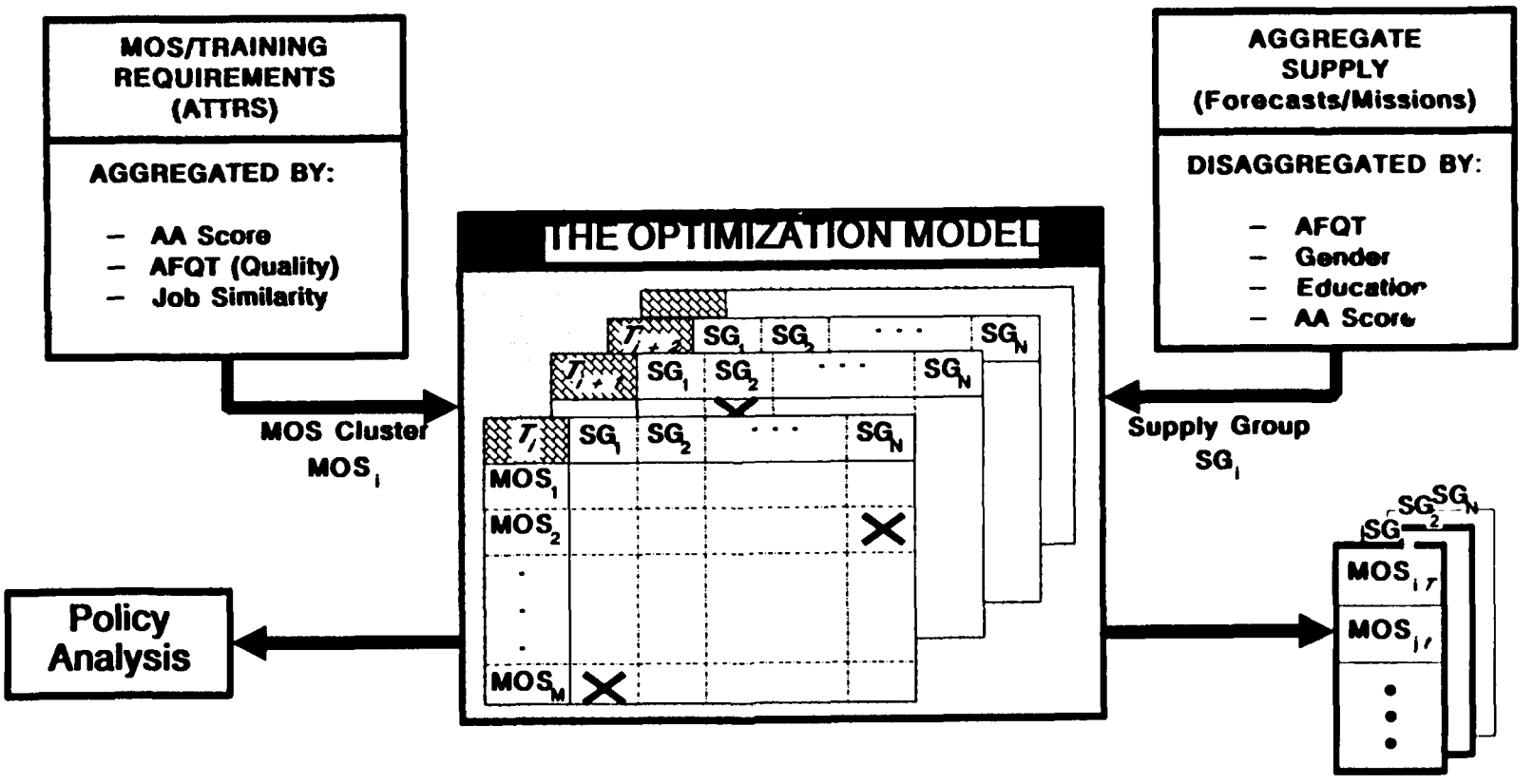
LP/Network Formulation
Optimal Guidance Methodology

MOS Cluster Formulation
MOS Requirements/Goals

Supply Group Formulation
Forecasting Methodologies

ENHANCED ALLOCATION SYSTEM

EPAS PROCESS



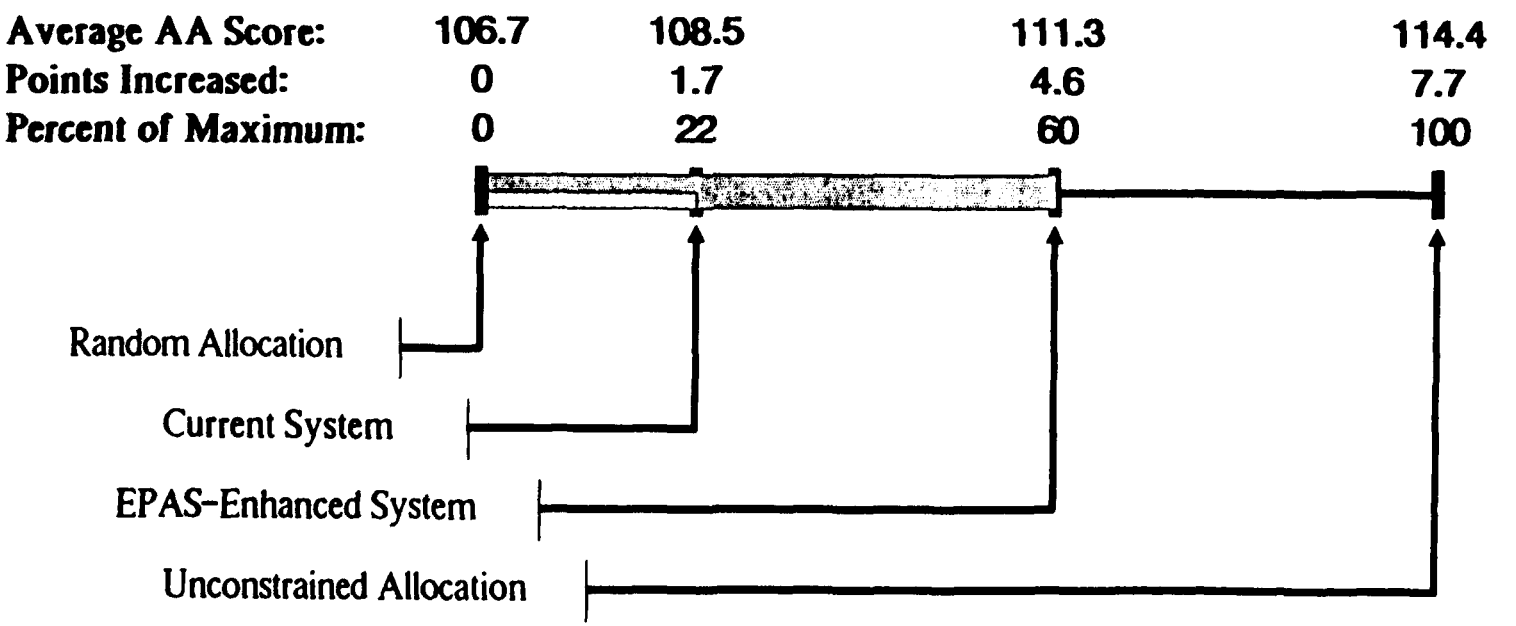
ENLISTED PERSONNEL ALLOCATION SYSTEM

SIMULATION CONCEPTS

- CASE-BY-CASE EVALUATION
  - Detailed applicant record
  - Current class seat status
- POLICY IMPLEMENTATION
  - Army/Congressional restrictions
  - Policy objectives
- MATHEMATICAL HEURISTICS
  - Emulate real-world
  - Analyst controls
  - Reproduceable

EPAS – ENHANCED SYSTEM
PERFORMANCE IMPROVEMENTS

(Figures based on FY86 Data)



ENLISTED PERSONNEL ALLOCATION SYSTEM

BENEFIT/COST RESULTS

	FY '84	BASELINE	LOW QUALITY	HIGH SUMMER TRAINING	PROB CHOICE	NO LOOK-AHEAD
ATTRITION REDUCTION (%)	–	5.5	4.9	7.5	6.6	3.5
COST SAVINGS ($M)		$30	$27	$41	$36	$19
AVE APTITUDE IMPROVEMENT (PREDICTOR S. D.) (%)	–	11	15	11	5	8
MOS RQMTS (%)	90	100	99	98	93	9[illegible]
QUALITY RQMTS (%)	88	98	74	97	89	96

ENLISTED PERSONNEL ALLOCATION SYSTEM

FIELD TEST

- OBJECTIVES :
  - Demonstrate operability w/in resource-constrained operational environment
  - Validate ISC-P conversion
  - Verify system enhancements since Benefit/Cost evaluations

- *NOT FIELD TEST OF A DEPLOYED SYSTEM*

- SCENARIOS
  - Baseline
  - Perturbed supply
  - Revised training demand

ENLISTED PERSONNEL ALLOCATION SYSTEM

FIELD TEST RESULTS

- **BASELINE--'86 formulations with '87 population**
  - **Data Issues**
    - HSDG vs HSSR
    - BT vs AIT
  - **Results**
    - 87% Annual Target
    - 93% Quality Target

- **SCENARIO #1--signifcantly lower quality (-35%) population**
  - **Results**
    - 87% Annual Target
    - 88% Quality Target

- **SCENARIO #2--new, high quality MOS**
  - **Results -- ?**

ENLISTED PERSONNEL ALLOCATION SYSTEM

CONCLUSIONS

- EPAS CONCEPT IS VIABLE
  - Optimization techniques can be applied
  - Optimal guidance can be utilized by sequential classification algorithms

- EPAS CONCEPT IS COST-EFFECTIVE
  - Significant dollar savings can be expected
  - Significant performance improvements can be expected

- EPAS OPERATES IN OPERATIONAL ENVIRONMENT
  - Data sources are available
  - Hardware/Software resources available
  - Scheduling resources available

ENLISTED PERSONNEL ALLOCATION SYSTEM

RECOMMENDATIONS

MAKE EPAS CONCEPT OPERATIONAL

- GENERAL REQUIREMENTS
  - Identify Function Proponents
    - -- input requirements
    - -- output requirements
  - Finalize Data Sources

- EPAS MODIFICATIONS
  - Simplify shell
  - Eliminate research hooks
  - Revised parametric control
  - Automate all interfaces and procedures

- REQUEST MODIFICATIONS
  - Revise search window
  - Accept optimal guidance

ENLISTED PERSONNEL ALLOCATION SYSTEM

RECOMMENDATIONS

CONTINUING RESEARCH ISSUES

- DYNAMIC SUPPLY GROUP ANALYSIS--develop means to automatically detect supply anomalies
- GOAL PROGRAMMING--enhanced methodology for disaggregating MOS Clusters
- PROBABILITY OF ACCEPTANCE--evaluate applicant's probability of acceptance as function of MOS
- MOS CLUSTER FORMULATION--automate MOS partitioning
- SUPPLY GROUP FORMULATION/FORECASTING--continued evaluation of best forecasting method
- EVALUATION OF PREDICTORS--continued evaluation and upgrade of new performance predictors